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CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

On the Improvement of the Ohio River. By ELLWOOD MORRIS, Civ. Eng.

(Continued from page 83.)

III. *Of Low Dams and Chutes, or Pool and Current Navigation.*

The author of this plan is Herman Haupt, Esq., Civil Engineer, (a gentleman of well deserved eminence in certain walks of the profession,) who has developed it, (though not very definitely,) in his pamphlet entitled "A Consideration of the Plans proposed for the Improvement of the Ohio River, 1855," summing up on page 44, in the following words, to wit:—

"That the true plan for the best improvement of the navigation, differs from any that has yet been proposed, and consists of a succession of pools formed by low dams of from 6 to 10 feet, connected by open channels not less than 200 feet wide, through which the water will flow free from locks, or any other obstruction, at the moderate velocity of two miles per hour."

And on page 42, he determines the fall necessary to give that velocity in a straight and uniform channel 200 feet wide to be, only one foot per mile, which "gives for the velocity in feet per second, 3·13."

now, $\frac{3{\cdot}13 \times 60 \times 60}{5280} = 2\frac{1}{10}$ miles per hour, from which the velocity is assumed in round numbers at 2 miles per hour. This proposed plan, so far as it can be gathered from the pamphlet quoted, is to erect low dams (*each of four feet lift*) across the river at suitable points, extending from

one shore within, say, 200 feet of the other; and then to connect the pools of these dams, or discontinuous wiers, by means of open channels or *chutes* of gentle slope (one foot per mile) formed by erecting or continuing from the end or opening of one dam, a bank 10 feet high lengthwise of the river, extending, on an average, 4 miles down-stream—this bank being placed 200 feet from one shore, and protected by a riprap or slope wall.

These dams would have a total height of 10 feet above channel-bottom, from which the depth proposed for the navigation, 6 feet, being deducted, leaves for *the lift* of each dam=4 feet.

The calculations of the pamphlet for the plan preferred, are evidently made upon the supposition of a straight and uniform section in the chute, *and a prolongation of one mile of chute for each foot of lift of dam.*

But the bank forming the chute, running only an average parallel to the irregular shore, will intercept both unequal widths and unequal depths, and, therefore, the calculations of permanent *regimen* will not strictly apply.

To make these chutes answer the calculations, all the sides of the water perimeter should be impervious; the chutes should have both uniform depth and uniform breadth, so as to produce a uniform section (as assumed in the pamphlet), or rather, one properly graduated in breadth, so as to maintain an uniform depth with a given inclination and supply of water, allowing both for friction and leakage. These conditions would require a regulation of the shore line also, so as to be nearly equivalent to two banks and a permanent bottom of regular slope, which does not seem to be provided for in the plan as laid down, nor is any account taken of the crooked line required to follow the shore.

The whole descent of the Ohio River, (the falls excepted,) being, say, 400 feet, this plan would require about 100 *dams* each of four feet lift, and 400 lineal miles of *chutes* to overcome them!

This assumes that to leave a proper margin of depth for the accumulation of deposits at the foot of each chute, an extra depth would be required, equivalent, at least in practice, to each dam setting back 6 feet against the next, so that we could hardly expect to avail ourselves of the fall of the chutes, to reduce the number of dams materially, though the pamphlet proposes to do so.

Besides, these dams would be so numerous, that to render the proposed navigation available to both shores, 6 feet deep must be maintained throughout the pools: *for if not*, one-half of the length of the river shores opposite to the chutes, or 400 miles lineal of one side, would be deprived of the benefits of the full depth proposed.

The Ohio River is now over 1000 feet wide, on 6 feet deep, and with that depth of water, *procured in the natural way*, makes a truly beautiful and useful navigation, one equally beneficial to both shores, and of a width not more than adequate to the transaction of the multifarious business which floats upon its bosom,—where we will often see within a few yards of each other, enormous rafts and clumsy coal boats descending the stream, while steamboats are passing in both directions; *all these* this plan proposes for a length of 400 miles, to crowd into crooked and narrow "*chutes*" of the very restricted and inadequate breadth of 200 feet!

A width in which it would be literally impossible for an ordinary steamboat to round to, or even to turn around!

It is well known that *descending steamboats*, upon rivers like the Ohio, can only land on the shores *by rounding to*, for which purpose they are specially planned, and carry their freight forward to land from the bow; but as it would be vain for any ordinary steamboat to attempt to round to in a *chute* only 200 feet wide, it necessarily follows, that during the low water season, 400 miles of the inner shore along these chutes, would be cut off from all communication with *descending boats*.

Now, as the pamphlet proposes to save dams by reducing depth outside the chutes, thus depriving the opposite or outer shore of the full benefit of the improvement, and as the chutes themselves would deprive the shores they follow of all communication with *descending* steamers, while the height of their outer banks would cut off the other side at low water, or at any rate, force all *ascending* trade from that outer shore *to descend first*, to the outfalls of the chutes: we have finally, about 800 miles of the river border, deprived in whole, or part, of the benefits of the proposed navigation during the whole low water season, by this miscalled *improvement!*

To each dam of four feet lift, would succeed a chute 4 miles long, to be formed by an earthen bank in the river some 10 feet high. This bank would necessarily have to follow the sinuosities of the shore, and if built of earth and stone, as proposed, could hardly fail to lose its salient angles or convex bends in every heavy flood.

The idea advanced in the pamphlet, that a bank 10 feet high and 4 miles long, (at each dam,) built of earth in the bed of the Ohio River, could be "*effectually protected*" by "a coating of stone placed by hand on the slopes," will hardly be considered as a serious proposition by those who know this river, and are familiar with such structures. That in many places these banks, notwithstanding their "*coating of stone*," would be demolished by every deep flood, is too certain to require argumentative proof.

The only safe formation of the chutes, would be to make each outer bank a continuation of its dam; nothing less secure would be likely to answer, because the chute bank would be less favorably situated in some respects than the dam itself; for the abutments of dams, which are always parallel to the stream, are often swept away, while the dams themselves remain undisturbed; we have, then, an entirely new feature in this plan (imposed by considerations of durability,) *and in this shape it proposes to construct* 100 *dams longitudinally of the bed of the Ohio River, each* 4 *miles long and* 10 *feet high!*

But there are other difficulties. The Ohio is continually receiving tributaries, numbering in all, nearly 200 large and small, between Pittsburgh and Cairo. Many of these would necessarily be intercepted by the chutes, yet the pamphlet does not attempt to show how this is to be managed, nor is it easy to do so. Now, these tributaries often rise high when the Ohio River is low, and rush perpendicularly across its channel. The annoyance given in this way by the Licking River, at Cincinnati, is well known. In such case the earthen bank proposed for the chutes would be entirely destroyed for some distance, and this could hardly fail to be a frequent occurrence, as every thundergust upon a small tributary, intercepted by a chute, might produce it, and suspend the navigation.

As to how these chutes are to be conducted past such rivers as the Hockhocking, the Muskingum, the two Kenawhas, the Sciota, &c., of the Upper Ohio, not to mention the great tributaries in its lower course, like the Tennessee and Cumberland, the pamphlet is entirely silent—though these questions are far from being unimportant, and could not fail to arise on some sections of a *chute*, having 400 miles of aggregate length.

The fall of the chutes proposed in the pamphlet, is fixed at *one foot per mile;* but this is only about the same as the average fall of the river between Pittsburgh and Wheeling, and hence, throughout this distance, the channel must either be continuous, only 200 feet wide, cutting off one shore entirely at low water, or else some other expedient would be necessary; and for this the pamphlet provides, by admitting on page 47, that here, "the assistance of reservoirs or the construction of a portion of slackwater would be indispensable;" but reservoirs adequate to maintain 6 feet deep above Wheeling, would render dams and chutes entirely unnecessary below that point; while slackwater would destroy or force the relocation of the railroads just finished along the right bank, so that not only private, but *corporate property* would be overwhelmed in a common damage by the plan proposed.

We will now consider the linear position of the banks of these chutes, and their effect in low freshets; placed lengthwise in the river in sections aggregating 400 miles in length, with a height of ten feet, they may be regarded as a low island of that length, submerged by all ordinary freshets, and forming in some stages of the water, one of the most dangerous obstructions it is possible to conceive of. The idea of placing 100 dangerous artificial bars, each four miles long, in the Ohio River, within 200 feet of one shore, and then attempting in freshets to indicate by "*buoys*" the position of these sunken banks, 400 miles long, and only 10 feet wide, in such a river as the Ohio, is hardly serious; and yet the pamphlet proposes merely *these buoys*, or the shore line dimly seen by night as an adequate guide, (when the chute banks are submerged,) to find a crooked and narrow channel only 200 feet wide, or to pick it out in fog or darkness from a uniform expanse of water six times that width! But neither buoys nor shore line, could prevent the current at curves and the mouths of creeks, from sweeping coal-boats, rafts, and even steamboats occasionally, upon these long and dangerous artificial bars, *and effectually wrecking them there.*

Although this plan will not augment the floods to the extent that would be caused by the higher dams proposed for a slackwater, it must nevertheless be remembered, that the proposition is at low water to keep up artificially, a 6 feet depth in the river instead of 2 feet, and therefore a freshet would necessarily find the channel of the river already full, and be compelled to flow over *an underline*, raised 4 feet higher than if these dams and chutes were away. Again, the positive obstacle at each dam, would be 10 feet high from the channel-bottom, and though a discontinuous wier (owing to the chute,) it would, nevertheless, have a material effect upon the surface line of freshets. In point of fact, there can be no doubt that some increased rise would be caused in floods by this system of dams and chutes, and though it may be difficult to assign a precise limit to it, yet from analogy, we can scarcely expect it to be less than 3

to 5 feet, while it may be more. This may seem small to many, but would be deemed more than enough by those whose property was periled by it.

We have seen, that it is proposed by these chutes to reduce the navigable width of the Ohio River, from an average of about a quarter of a mile, down to only 200 feet for 400 miles of its course, or nearly half its length. We will now add, that while this comparatively petty canal, is utterly inadequate for the manœuvres of steamboats, a single pair of coal-boats sunk in it by one of the numerous collisions of which this plan could hardly fail to be prolific, would suspend the navigation for days, if indeed it did not produce other wrecks, and longer continued delay.

While the slack-water plan, at least, proposed to give us in the pools a noble navigation a quarter of a mile wide, of an ample depth, and a general character, going far to compensate us for delay at the locks, and other evils, and required the aid of reservoirs *only*,—the plan before us not only proposes to reduce this fine river, to a comparatively petty canal for nearly half its length, but is so incomplete within itself, *as to require the aid of slack-water and of reservoirs both!*

We will now notice another effect that may be expected from the proposed plan of dams and chutes, or pool and current navigation—it is *the formation of bars at the outfalls of the chutes*. By this plan the present uniform current of the Ohio, would be *broken and deadened*, by the pools in sections amounting to about half the length of the River, while on the other half, the velocity of the current would be *more than doubled*:—in technical language, *the regimen of the river would be destroyed*; the result of this is certain, and may be best explained in the words of an elementary work on Civil Engineering, to wit:—

"Bars are formed at those points, where from any cause the velocity of the current receives a sudden check. The particles suspended in the water, or borne along over the bottom of the bed by the current, are deposited at these points, and continue to accumulate, until by the gradual filling of the bed, the water acquires sufficient velocity to bear farther on the particles that reach the bar, when the river acquires and retains a fixed regimen, until disturbed by some new cause."—*Mahan*, p. 341, Ed. 1853.

In conformity to the above elementary principle, *bars* would inevitably accumulate at the outfalls of all the *chutes*, (100 in number), and form *obstructions*, calling for incessant *dredging*.

We will now refer to a case where this plan has been actually tested, though it may not have been known to the author of the pamphlet—the plan of low dams and chutes, as proposed, has already, upon a working scale, been put in action upon the Ohio River, by the Government Engineers, *and with a want of success too signal to encourage new trials.*

It is at the well known spot called *Buffington's Island*. Here the River divides itself into two channels of very unequal size, the main body of the stream going on the Virginia side of the island, while along the Ohio shore, is a uniform and narrow channel, for the most part quite direct, *forming a chute, in fact, and so called by the boatmen.*

The island itself is about a mile long, forming one bank of "*the chute*," the Ohio shore the other. The chute itself is about 200 feet wide, and the main channel of the River is stopped by "*a low dam*," extending from the island to the Virginia side. It forms, in truth, precisely what

is described in the pamphlet, "*a low dam and chute.*" It is a fair experiment upon a working scale, and if there were any thing useful in the plan, it would necessarily show at this place, *some beneficial result;* but the fact is just the reverse. *Buffington's Island*, (as the whole arrangement here is briefly called by the boatmen), is well known as forming one of the most serious obstructions in the Ohio River, and it would create no little excitement amongst the river men, to learn that a civil engineer had gravely proposed *artificially, to repeat this celebrated obstacle in a hundred places!*

The writer cannot be mistaken in the topography of *Buffington's Island*, having, in company with a hundred other passengers, spent one miserable day, promenading in a snow storm along the banks of "*the chute*," disconsolately viewing a dozen steamboats grounded in it, or glancing anxiously at another steamer, which had borne us with little difficulty from Pittsburgh, but now lay stranded upon the "*low dam*," where she remained for three days.

In discussing the plan of low dams and chutes, the pamphlet assumes, "that the depth of ordinary low water upon Wheeling Bar is 2 feet; but it is occasionally much less than that. Thus in the year 1838 alone, it appears there were 93 days when the River at Wheeling stood at 2 *feet or under*, while for 28 days it stood at *one foot or under!*

Now, as works of this sort must be planned for extreme cases, in order to be constantly useful, it is necessary to assume low water on Wheeling Bar at what it really is, *or one foot only.*

This would make a material difference in the pamphlet calculations, render a much greater amount of assistance necessary from reservoirs, and would detract considerably from the apparent feasibility of the plan before us.

The plan of construction of the low dams and chutes, is much too obscurely stated in the pamphlet to justify a detailed estimate of cost, and its author indeed seems to have waived that important consideration, by not giving us the value of his unit of comparison,—"an equal length of railroad."

The expense, however, of substantial structures for dams and chutes, would be very great, and with the *slack-water* above Wheeling, and the *reservoirs* required as auxiliaries, would not probably fall short of *twenty millions of dollars.*

But it does not appear worth while to prolong this subject, and we will now conclude by briefly summing up the chief objections to an attempt to improve the Ohio River Navigation, by means of "*low dams and chutes.*"

1. That this plan is crude and imperfect, requiring the aid of reservoirs and slack-water both, and yet depriving in part of the benefits proposed, about 800 miles of river shore.

2. That it proposes to contract the channel for 400 miles in all, to a width of only 200 feet, which is less than the length of an ordinary steamboat, and in which it would be impossible for them either to turn, or round to.

3. That it proposes in connexion with these insufficient channels, to erect 100 dams across the River 10 feet high, and to form chutes at each by prolonging a wing down-stream 4 miles long and also 10 feet high;

these wings or chute banks, each 4 miles long, forming most dangerous artificial bars in low freshets at 100 places.

4. That while proposing artificial obstructions in the channel, both transversely and longitudinally, it promises to create 100 natural bars besides.

5. That it will produce an augmentation of the floods, of from 3 to 5 feet, or more, in all probability.

6. That it has been already tried upon a working scale at *Buffington's Island*, and has entirely failed in its design.

7. That it would probably cost twenty millions of dollars, if substantially constructed.

The pamphlet we have referred to, discusses also two other plans—high dams with retaining reservoirs, and low dams with retaining reservoirs. In these there is nothing new, (except in the unwise proposition to place them in the main River,) for they have been already suggested by Mr. Ellet to be placed upon the *navigable* tributaries of the Ohio, and to form there "Regulating Reservoirs."

In this way they can probably be made serviceable, but in the main channel of the Ohio they would be so very objectionable, that it is to be hoped the plan will not be seriously entertained.

Dams with retaining reservoirs are not new to the engineering profession, having long been used, and it is not necessary to go into an examination of their merits at this time.

Concluding Remarks.

We have now briefly examined the leading plans proposed for the improvement of the Ohio River Navigation. We find that the Reservoir Plan is incomparably superior to any of the others, and we have also seen the singular fact admitted by the advocates of the rival plans, that neither of the others are likely to answer any good purpose, *without assistance from reservoirs.*

Here, then, is common ground, and as all the plans require reservoirs, *is it not manifestly the best policy to build those reservoirs first?*

It is admitted they will be needed as auxiliaries even by a slack-water navigation, whilst on the other hand it is confidently argued, that reservoirs *alone*, are adequate for the improvement of the Ohio River

The part of prudence, then, is to build the reservoirs *first*, and if they fail to answer their intended purpose as *principals*, there can at least be no doubt of their utility as *auxiliaries*. Having, therefore, by the construction of reservoirs obtained the means of controlling or mitigating the floods, *the slack-water navigation can be carried out if it should ever be found necessary.*

In this manner nothing would be lost, we should be commencing at the right end, and our progress would be uniformly onward, until a permanent improvement of this noble River, was fully and satisfactorily accomplished.

On the other hand, if a slackwater navigation, or low dams and chutes, were built and *failed*, it would be a most expensive work to remove these obstructions from the channel, besides incurring a dead loss of the whole original outlay, and being compelled to go back *to reservoirs at last!*

To construct these reservoirs for the improvement of a River in which (adding Missouri,) the people of *seven* powerful states are interested, we must depend upon the action of the General Government, with the concurrence of the States of Virginia and Pennsylvania alone, whose right of eminent domain would have to be invoked to obtain possession of the reservoir sites on making adequate compensation to the owners.

After the construction of these reservoirs, should it be deemed advisable to employ them only *as auxiliaries* to a slack-water navigation, such navigation can be left to a corporation created by the concurrent action of the bordering States, and strictly limited in their charges.

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Appendix.

Since the above was in type, the writer has had placed in his hands, a pamphlet "On the Improvement of the Ohio River," written by W. Milnor Roberts, Esq., Civ. Eng., in which he announces himself as "an advocate of the system of locks and dams on the Ohio River," which he is said to have proposed as early "as the year 1839," and certainly no better sponsor for it could be desired, since the skill and experience of that gentleman as a Civil Engineer cannot be doubted.

This slashing pamphlet is a skilful and studied attack upon the plans and propositions originated by Mr. Ellet, and raises questions of fact which a survey *alone* can settle, though wisely admitting the *practicability* of the Reservoir Plan.

Between these able engineers, the writer is not at all inclined to interpose, but nevertheless, it appears necessary to notice briefly here, a portion of this new matter.

Mr. Roberts proposes dams of 8 feet lift, and to clear the slack-water plan of the just imputation of embarrassing if not destroying the descending navigation, "for arks, rafts, &c.," states that his plan "contemplated the introduction of *sluice ways* which could be easily navigated by arks and rafts," but he has evidently overlooked the important fact, that these arks when laden with coal, *draw six feet water*, or actually require more water for their floatation than the steamboats do!

From this little fact, an important consequence flows, for if these sluice-ways or chutes are so arranged as to admit the *safe* passage of those burdensome but frail boxes of pine lumber, called "*coal arks*," *which draw six feet of water*, it is clear, that they must also answer for the transit of the stronger steamboat which never draws so much; *and hence the locks would be useless.* In this shape, this plan, in fact, becomes the plan of Mr. Haupt, that of "low dams and chutes," noticed in the 3d division above—the objections to which are insurmountable.

While Mr. Roberts proposes to provide for the descending navigation in his slack-water plan, which indeed is indispensable in any plan, he attempts to show that reservoirs upon the great affluents of the Ohio will necessarily destroy the very important *lumber trade*, which now comes from the forests near their sources: but, in this, it appears to the writer, he entirely fails.

For the establishment of reservoirs upon the great affluents, far from prejudicing the lumber trade, will confer a benefit on it, by forming large and quiet pools to collect it together; acting, in fact, like the *Booms*, so often employed upon our lumber rivers.

Once collected within the pools of the reservoirs, both logs and lumber would be floated from them, *through the reservoir dams*, at periodic seasons, by means of substantial contrivances, which any skilful engineer charged with these works will know how to plan, construct, and operate with entire success.

That the lumber will only be passed down at *stated periods*, forms no objection: since, with unobstructed streams, it is only *occasionally*, and at very *uncertain* times, that it can now be run at all.

There are *five* very important objections to the "system of locks and dams on the Ohio River," which Mr. Roberts has studiously, if not wisely, declined to meet; any one of the first four of these is fatal to the slackwater plan, and when we consider that it is proposed to carry it out under the direction of *a corporation*, the fifth is fatal too, to wit:

1. The augmentation of freshets by slack-water pools.
2. The increased obstruction from ice.
3. The damages to town and country property.
4. The expense of maintenance.
5. The tolls necessary to be charged for maintenance alone, if not for interest, and corporate profits.

And we may add that not the least of the legitimate objections to Mr. Roberts' "system of locks and dams on the Ohio River," is, that it is proposed to carry it out by means of *an incorporated body*, which is even now soliciting from the Congress of the United States, a grant of land ostensibly to effect this so-called improvement, but really using the popular name of the Ohio River to cover *a mere land speculation.*

A speculation like some of those now in progress in the north-west, based upon railroad schemes in the wilderness, the operators in which, do not hesitate to avow to each other, "*that they care nothing about the railroads, it is the Government lands they are after!*"

So it is to be apprehended, that a grant of Government lands to the Ohio River Corporation will end, not in an improvement of the Ohio River, *but in the loss of the lands to the Country.*

For the Journal of the Franklin Institute.

A simple method of finding the Helicoidal Surface of a Screw Propeller, and the Practical Development of such Surface upon a Plane. By James H. Warner, Eng. Corps., U. S. N.

From a great variety of fantastic designs, the screw propeller has been so far improved that we may with propriety consider a uniform, or *true* screw, the rule, and all other forms an exception.

Griffith's screw is perhaps the only important deviation from ordinary practice that has other than an ideal existence, and his screw is made uniform for a given pitch, whilst the blades are movable to a certain extent in order to increase or diminish the pitch. But this form is limited to cases where the screw can be easily dismounted by hoisting it out of position, a system of arrangement almost exclusively confined to auxiliary steam vessels for naval service.

Aside from the importance of ascertaining the best form and dimension, there are other points connected with the design and construction of a screw, which claim the attention of the mechanical engineer, and the object of this paper is to furnish a simple suggestion with reference to the helical surface of a screw, and the development of such surface upon a plane.

The operation here described is but an adaptation of the centrobaric principle, or the "Guldinus" properties of bodies, as stated in the following proposition:

"If any straight or curved line, or plane surface bounded by curved lines, revolve about an axis situated in the same plane with the lines or surfaces, the surface or solid thus generated will be respectively equal to a surface or solid whose base is equal to the given line or surface, and whose height is equal to the arc described by the centre of quantity of the generating line or surface."

Let B D, fig. 2, Plate III, be a circle, of which B E is the radius. Now, then, if the line B E revolve about the point E, the extremity will describe the circumference whilst the line itself will describe the area of the circle. From the principles of mechanics, we know the centre of gravity of a straight line lies in its centre; then bisecting the line B E gives the point *a*, which with the radius *a* E describes the circumference *a b*. Hence from the above proposition, the area of this circle is equal to a rectangle of which the line B E is the base, and the circumference *a b* the height; or in other words, the area of a circle is equal to the product of the radius B E, into the distance traversed by its centre of gravity.

Applying this to the screw, let B D be the circumference, and B E the radius, which, in this connexion, may be called the *generatrix;* whilst the point B describes the circumference, the line B E moves in the direction of its axis a distance equal to the pitch, generating a twisted or helical instead of a plane surface, and the development of the path traced by the point B is the hypothenuse of a right angled triangle (fig. 2), of which the circumference B D is the base, and the pitch A B the perpendicular. In like manner the helical path of the point *a* is the hypothenuse of a similar triangle of which the circumference *a b* is the base, and the pitch a perpendicular, whence the area of one thread for one convolution is equal to a rectangle, the base of which is the radius, and whose height is equal to the hypothenuse A 1. That is to say, multiply the radius of the screw by the development of its centre of gravity or the hypothenuse A 1, for the whole of the area thread, and this product again multiplied by the mean fraction of pitch used gives the area of such fractional part. This product includes the whole surface from axis to periphery, consequently, to obtain the effective area that portion within the hub must be deducted. Referring to fig. 2,

A B = Pitch of screw.
B D = Circumference of do.
A D = Development of exterior helix.
A C = " " " of hub.
A 1 = Helical path of centre of gravity of radius of screw.
A 2 = " " " " hub.
R = Radius of screw. R′ = Radius of hub.
F = Mean fraction of pitch.

Then $\sqrt{\text{A B}^2+\text{B 1}^2}=\text{A 1}$.

and $\sqrt{\text{A B}^2+\text{B 2}^2}=\text{A 2}$.

Whence

(R × A 1)—(R¹ × A 2) = area of thread for one convolution.

or

(R × A 1)—(R¹ × A 2) × F = effective area for any fractional part.

Applying to this the screw of the U. S. Steam Frigate, "*Minnesota*," having the following dimensions:—

Diameter,	17 feet 4 inches.
Pitch,	23 "
Length,	3 " 6 "
Diameter of hub,	2 " (mean.)
Number of blades,	2

We have,

A B = 23 feet.	B 2 = 3·1416 feet.
B D = 54·44 "	B C = 6·283 "
A D = 59·09 "	B 1 = 27·22 "
A C = 23·84 "	R = 8·66 "
R¹ = 1 foot.	$F=\frac{3\cdot5}{23}\times 2=\cdot3042$

$$\text{A 1}=\sqrt{23^2+27\cdot22^2}=35\cdot64.$$

$$\text{A 2}=\sqrt{23^2+3\cdot1416^2}=22\cdot2.$$

Whence,

(8·66 × 35·64)—(1 × 22·2) = 286·6 square feet area for one full thread.

or

(8·66 × 35·64)—(1 × 22·2) × ·3042 = 87·188 sq. feet area of two blades.

This operation admits of similar application when the pitch expands radially or in the direction of its axis, and with either an *oblique* or *curved* generatrix.

The development of one blade of the screw cited in the preceding example is shown in fig. 3. The angle of this blade at periphery is 22° 54′ 10″, increasing gradually from thence to the axis or 90°, at the hub it is 74° 43′ 14″.

If a cylinder be cut at any other than a right angle with its axis, the section will present an elliptic or rather an oval figure, consequently, if we observe the exterior helix of a screw from a point perpendicular to its direction, the curve of the extremity of the blade will be similar to that of the transverse side of a cylindrical section cut at a corresponding angle, and the same would result for any other point, lying in a line perpendicular to the axis passing through the centre of the blade, the curve changing with the angle.

The diameter of this screw is 17·33 feet, and the angle at periphery, 22° 54′ 10″; hence, to obtain a curve of the blade at this point, we have simply to describe that of a cylindrical section cut at this angle, of which the perpendicular line through the centre of the blade, or the radius, is the minor axis, and the diagonal cutting the sides of the cylinder the major axis.

The radius is 8 feet 8 inches, which I have divided into 8 spaces of 1 foot each, and one of 8 inches, and have drawn the curved helices, 1, 2, 3, 4, 5, &c., corresponding to the sections of cylinders, 2, 4, 6, 8, 10, &c., feet diameter.

The length of the helices were calculated by the formula,

$$\sqrt{2\pi r^2 + \text{Pitch}^2} \times \frac{\text{length}}{\text{pitch.}}$$

These lengths measured upon the curves give the points 1, 2, 3, 4, 5, &c., through which the line is traced, indicating the shape of the developed blade. The horizontal dotted lines represent the respective semi-major axes and the vertical dotted lines the radii or semi-minor axes.

I have arranged the calculations from which the diagram was drawn in the following tabular form, and which, with the exception of column G, requires no further explanation.

Diameter.	Circumference.	Hypothenuse.	Angles.	Semi-axis (major.)	Semi-axis (minor)	Radius of curve.	Helix.
A	B	C	D	E	F	G	H
	$A \times 3{\cdot}1416$	$\sqrt{B^2+23^2}$	$\frac{B}{23} = \tan.$	$\frac{\text{Sec. D} \times B}{2}$	$\frac{A}{2}$		$C \times {\cdot}1521$
feet.	feet.	feet.		feet.	feet.	feet.	feet.
2	6·283	23·84	74° 43′ 14″	3·80	1	13·514	3·626
4	12·56	26·20	61° 21′ 39″	4·17	2	8·854	4·000
6	18·84	29·74	50° 40′ 38″	4·73	3	8·125	4·524
8	25·13	33·66	42° 27′ 53″	5·42	4	7·375	5·119
10	31·41	38·48	36° 12′ 46″	6·20	5	7·604	5·853
12	37·69	44·15	31° 23′ 12″	7·02	6	8·166	6·715
14	43·98	49·63	27° 36′ 26″	7·90	7	8·958	7·548
16	50·26	50·26	24° 35′ 21″	8·74	8	9·625	8·406
17·33	54·44	59·09	22° 54′ 10″	9·36	8·66	10·187	9·000

The radii of the curved helices were obtained by means of a subsidiary diagram similar to fig. 4., as follows:—Draw two lines *j o*, *j n*, at any convenient angle, make *j k* and *j m* respectively equal to the semi-axis, then with the distance *j k* and *j m*, cut *j n* in *l* and *n*; join *l* and *m*, and from the point *n* draw *n o* parallel to *l m*, the distance *j o* will be the radius of a circular arc which will nearly coincide with an elliptic curve to a greater extent than the helix of the blade of an ordinary screw. This radius may be otherwise and perhaps more conveniently obtained, as follows:—join the extremity of the two axes by the diagonal *a f*, fig. 3, upon which, from the point *b* of the rectangle *a b f c*, let fall a perpendicular *b h* extended so as to intersect the vertical line *a c*, gives the point from which the curve is drawn.

Fig. 5, is simply a *working sketch* showing thickness of metal &c., and from which it is apparent that lines traced through the extremities of helices measured upon straight lines do not approximate to the true shape of the blade.

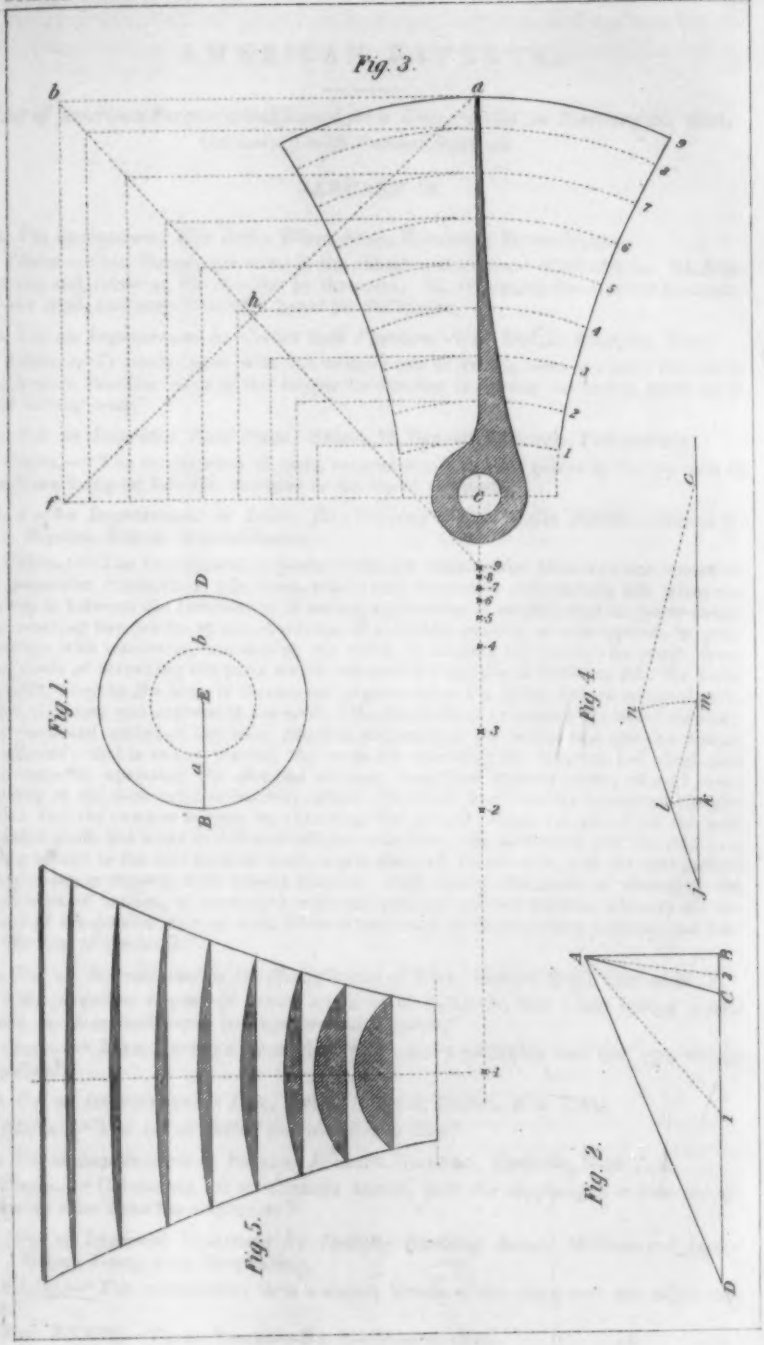
Fig. 3.
a
b
c
h
9
8
7
6
5
4
3
2
1
0
D
b
E
a
B
Fig. 1.
c
m
n
l
k
j
Fig. 4.
A
B
C
D
Fig. 2.
Fig. 5.

AMERICAN PATENTS.

List of American Patents which issued from January 13th, to February 3d, 1857, (inclusive,) with Exemplifications.

JANUARY 13.

44. For an *Improved Fire Arm;* Ethen Allen, Worcester, Massachusetts.

Claim.—"1st, Placing the valve in the chamber, at the base of the nipple. 2d, Supporting and retaining the chamber by the parts. 3d, Operating the rammer by means of the lever, said lever forming a guard for the trigger."

45. For an *Improvement in Cotton Seed Planters;* Wm. Badger, Memphis, Tenn.

Claim.—"In combination with one or more sets of feeding arms, centrally located in the hopper, the false sides in the hopper for drawing or forcing the cotton seeds up to said feeding arms."

46. For an *Improved Field Fence;* Seneca H. Bennett, Belleville, Pennsylvania.

Claim.—"The combination of posts, secured firmly in their places by the top rails of the fence being let into the mortises in the top of the posts."

47. For an *Improvement in Looms for Weaving Pile Fabrics Double;* Erastus B. Bigelow, Boston, Massachusetts.

Claim.—"The employment in power looms for weaving two fabrics at one operation of transverse intersecting pile wires, when said transverse intersecting pile wires are woven in between the two fabrics. Also, the application or employment in power looms for weaving two fabrics at one operation, of a double positive shuttle motion, in combination with transverse, intersecting pile wires, for keeping the two fabrics apart. Also, the mode of arranging the parts which connect the shuttle or shuttles, with the loom shipper, whereby the loom is thrown out of gear, when the filling fails in either shuttle. Also, elevating and depressing the reed. Also, the mode of arranging the cams, whereby the combined action of the lathe, shuttles, intersecting pile wires, and ground warps, is effected; that is to say, placing the cams for operating the lathe on the shaft, and the cams for operating the shuttles on their respective counter shafts, all said cams moving at the same relative velocity, whilst the crank and cam for operating the pile wires, and the cams or tappets for operating the ground warps, are placed on the said counter shaft, but move at different relative velocities; the said crank and the said cam being affixed to the said counter shaft, whilst the said shuttle cam, and the said ground warp cams, or tappets, turn loosely thereon. And, finally, the mode of arranging the double let-off motion, in connexion with one positive take-up motion, whereby the delivery of the ground warp of each fabric is regulated by its respective tension, and held at the beat of the lathe."

48. For an *Improvement in the Manufacture of Hoes;* Samuel Boyd, City of N. Y.

"My invention consists of a new article of manufacture, viz: a hoe, having a steel blade, and a malleable cast iron eye, welded together."

Claim.—"A hoe, having a sheet steel blade, and a malleable cast iron eye, welded together."

49. For an *Improvement in Dies;* Robert Brayton, Buffalo, New York.

Claim.—"The use of chilled cast iron die, or dies."

50. For an *Improvement in Pumps;* James S. Burnham, Yorkville, New York.

Claim.—"Combining the air chamber directly with the diaphragm, so that the air chamber rides upon the diaphragm."

51. For an *Improved Implement for Holding Blacking Boxes;* William and Jasper Cairns, Jersey City, New Jersey.

Claim.—"The combination with a slotted handle of the stops and the adjustable jaw."

52. For an *Improvement in Knitting Machines;* Enoch Colvin, Poultney, Vt.

Claim.—"1st, The use of two circles of needles, for knitting a ribbed fabric. 2d, The method of moving the feeders by means of grooved eccentrics, with curves in the grooves."

53. For an *Arrangement of Fixed Rails as a Substitute for Railroad Switches;* Jos. T. Davenport, Augusta, Georgia.

Claim.—"The arrangement and form of the rails and guards to produce the connexion between the sidelings and the main track on railroads."

54. For an *Improved Mode of Rifling Ordnance;* Horace E. Dimick, St. Louis, Mo.

"The nature of my invention consists in cutting the grooves straight from the base of the bore, to about the distance of the trunnions, where the required twist shall begin; and in combination with this manner of grooving, giving the gun what is termed a freed bore of from one-one hundredth to one-tenth of an inch, depending on the calibre freeing the grooves, to double the extent of the bore."

Claim.—"A system of straight grooves, extending from the base of the bore to about the position of the trunnions, and twisting from thence to the muzzle, in combination with a freed bore, as an improved mode of applying the rifle principle to ordnance."

55. For an *Improved Automatic Regulator for Wind Wheels;* Joseph Dunkley, Carrollton, Maryland.

"The nature of my invention consists in the construction of an automatic governor."

Claim.—"The employment of the slide wing."

56. For an *Improvement in Burning Fluid Lamps;* M. B. Dyott, Philadelphia, Pa.

Claim.—"Removing the metallic connexion between the main and auxiliary burner of a fluid lamp, so far from the flame, or heat, interposing a non or bad conducting material between the burner and lighter, as that the heat of the main burner shall not be transmitted to the auxiliary, whilst the efficiency of the latter is in no wise impaired."

57. For an *Improvement in Stair Cases;* Augustus Eliaers, Boston, Massachusetts.

Claim.—"The improvement in the construction of stair cases, the same consisting in forming separate and independent 'string pieces,' between which the treads are held and griped—the whole being secured by a screw bolt, that forms a part of, or is attached to, the baluster."

58. For an *Improvement in Platform Scales;* Thaddeus Fairbanks, St. Johnsbury, Vermont.

Claim.—"My improved arrangement and combination of four bearing multiplying levers, a multiplying lever, and a lever, made so as to act at the same time, as an equalizing and multiplying lever. Also, arranging the suspension bridge, so that its arched standards shall extend upwards by the sides of the platform, and between it and the sides of the pit, in combination with arranging the transverse levers and their bearings below the platform, the same affording the necessary room for the vertical play of the longitudinal levers, while it secures an advantage as regards the depth of the pit."

59. For an *Improvement in Sewing Machines;* Milton Finkle, City of New York.

Claim.—"The construction and use of the loop former, for the purpose of parting the thread from the needle, so that the shuttle will be certain to enter."

60. For an *Improvement in Flour Bolt as applied to Grinding Mill;* Sanford E. Fitch and Theodore Sharp, Greenbush, New York.

Claim.—"The employment of the shaft and bolter, constructed and arranged so as to take the meal from the mill, and bolt it in successive and graduated portions, so as to prevent the finer portions of the meal from continuing unnecessarily in the mill, whilst the coarse particles return to the cylinder to be re-ground, or in certain cases, the substitution of a shelf in place of the bolter."

61. For an *Improvement in Locomotive Lamps;* Lewis A. Hamblen, Chicago, Ill.

Claim.—"Making a locomotive lamp, with three or more distinct chambers, said chambers all being arranged on the same level, and connected by two tubes, which run parallel, but not in line with one another, and provided with two elevated vent passages, which communicate with the ordinary vent passages."

62. For an *Improvement in Brick Machines;* Jacob Hockman, Mexico, Indiana.

Claim.—"The under frame or carriage, and trucks or rollers, in combination with the main supporting wheels and rotating cylinder of moulds."

63. For an *Improved Device by which Persons approaching may open Gates;* Royal E. House, Binghampton, New York.

Claim.—"The process for opening and closing road gates while riding on horse-back, or in a vehicle, through the gate passage; also, the apparatus."

64. For an *Improvement in Sewing Machines;* A. F. Johnson, Boston, Mass.

Claim.—"Combining the hook when furnished with a lever or arm, with the eccentric band, screw, and the adjustable projection or screw, for the double purpose of taking, first, the loop properly from the needle, and, secondly, for actuating the hook at the proper time for the needle to take the loop from the hook."

65. For an *Improvement in Hay Forks;* William Jones, Speedsville, New York.

Claim.—"The slotted socket, for the reception of the tangs of the tines, when used in connexion with the wedges, screw, and ferrule."

66. For an *Improvement in Presses;* Rhodolphus Kinsley, Springfield, Mass.

Claim.—"The compound action of the cam and eccentric, or their equivalents."

67. For an *Improvement in Balance for Detecting Counterfeit Coin;* H. Maranville, Clinton, Ohio.

Claim.—"The graduated disk and slide, connected and hung in the ears or lugs—the disk having ledges or guides attached to its face."

68. For an *Improvement in Oil Press;* Wm. W. Marsh, Jacksonville, Illinois.

Claim.—"Providing the lower or piston surfaces of the trusses, with vertical flanches and side pieces, when a space is left between said side pieces and the bottom piston surfaces."

69. For an *Improvement in Hand Looms;* Stephen C. Mendenhall, Richmond, Ind.

Claim.—"1st, The universal treadle cam, cam, shaft, spring, and hinge, in combination with the revolving cam, wheel, connecting rod, brace, hook, pin, and spring. 2d, The cords and pulleys, in combination with the spring, arms, triggers, and cords, for the purpose of throwing the shuttle back and forth through the loom."

70. For an *Improvement in the Cutting Apparatus of Harvesting Machines;* Robert J. Morrison, Richmond, Virginia.

Claim.—"The peculiar form of the lid, which overlies the cutters, viz: a lozenge or spear shaped point, and rhomboidal base, for the purpose of giving an oblique direction to the joints between said lids, to prevent the grass gum, or other material, from clogging said joint, and checking the efficiency of the lids."

71. For an *Improvement in Cotton Gins;* James F. Orr, Orrville, Alabama.

Claim.—"The combination of the two short ribs, the latter arranged in relation to the saw cylinder."

72. For an *Improved Machine for Rolling Tapering Tubes;* Wm. Ostrander, City of New York.

Claim.—"The combination with a tapering mandrel of cylindrical rollers, formed of disks or sections, for the purpose of rolling a tapering tube."

73. For an *Improvement in Nipple Shields;* James Parker, Boston, Massachusetts.

Claim.—"My improved nipple shield, constructed with a tubular cap, viz: one which shall only encompass the nipple on its sides, and not cover the front or end thereof, the whole front of the nipple guard being open."

74. For an *Improvement in Excavators;* Wm. Provines, Columbia, Missouri.

Claim.—"In combination with the scoops that cast their contents from them, the trigger and spring, for the purpose of regulating the point at which the scoops shall divest themselves of their load, so as to raise it higher, or cast it farther from the trench that is being cut."

75. For an *Improvement in the Construction of Burning Fluid Lamps;* David F. Randall, Chicopee, Massachusetts.

Claim.—"So applying to the gas burner, a tapering spur, that it may extend down into the body of the wick, and serve to conduct heat into the interior of the wick, while the external sides of the wick are heated by the burner and wick tube; and when such spur is used, I claim making it with one or more branches at top."

76. For an *Improved Tubular Auger;* J. A. Reynolds, Elmira, New York.

Claim.—"The employment of an auger, whose shank or stem shall form a screw, when combined with a guiding tube surrounding the screw shank of the auger, but not covering the head thereof. Also, the use of the guide tube, when combined with the sliding carriage—said carriage constructed with the slide."

77. For an *Improved Method of Hanging Farm Gates;* Isaac S. Roland, West Earl, Pennsylvania.

Claim.—"Constructing the upper hinge of said gate of the peculiarly shaped hinge arm, the pawl, and the cam, when the said parts are combined and operated with each other, in connexion with the loose play of the bracket pivots in the eyes of the upper and lower hinge arms."

78. For an *Improvement in Cotton Cultivators;* Joseph Shaw, Richland, Georgia.

Claim.—"In combination with the hoes, having both a vertical and lateral adjustment, the shoes above them, and so adjustable on or with said hoes, as to serve to throw the earth towards or from the plants, as may be required."

79. For an *Improved Hub Borer;* John Shaerer, Reading, Pennsylvania.

Claim.—"The vertically movable nut, in combination with the cutter shaft."

80. For an *Improved Machine for Planing Shingles or Tapering Pieces;* Reuben W. Sharp, Montgomery, Alabama.

Claim.—"The combination of the reciprocating slide and vibrating and rotating cutter head, with or without the stationary cutter head."

81. For an *Improved Mode of Constructing Mail Axles and Hubs;* Alfred E. Smith, Bronxville, New York.

Claim.—"The method of constructing a mail axle; that is to say, making the end of the box abut against the inner side of the collar, instead of against the holding plate, whereby the wear of the washer between the collar and the holding plate, may be compensated for by setting up the bolts."

82. For an *Improvement in Looms;* Daniel W. Snell and Stephen S. Bartlett, Woonsocket, Rhode Island.

Claim.—"1st, employing the positive take-up mechanism or cloth roll, as the point through which the variable strain and wind of warps is made to act more sensitively than from or by the variable vibratory reacting motion of the whip rolls, or sudden jerking of the beam or movable reeds. 2d, Effecting and producing a regular delivery and uniform strain of the warps by the equalizing strain lever—said strain lever being acted upon by the variable strain of the warps, through the positive take-up mechanism or cloth roll. 3d, The equalizing strain lever, acting in combination with the take-up mechanism and cloth roll. 4th, The equalizing strain lever, when operating in connexion with the positive take-up mechanism, in combination with any mechanism for producing rotary motion to the beam, and with any device or means for regulating the delivery and strain of the warps, as the beam decreases in diameter, and as the desired strain requires. 5th, Employing the rod with the pin, or equivalent, to act upon the strain lever as a means of moving the weight when the balance spring, or equivalent device, is not sufficient to move it. 6th, In combination with the pulley and pinion, the movable weight, the fixed yielding sectional friction piece, and friction lever. 7th, In combination with the weight and friction lever, the rack, or its equivalent, so as to act upon weight through catches, or analogous devices, as to gradually move the weight towards the fulcrum of lever, as the beam decreases in diameter, and as the desired strain of warp requires. 8th, In combination with the weight and friction lever, the jointed or stationary sectional friction piece and set screw."

83. For an *Improved Bore or Support for Posts of Field Fences;* Obed Spencer, Jacksonburg, Ohio.

Claim.—"The chair or base formed of the pieces, and ties or buttons, in combination with the posts."

84. For an *Improved Machine for Sawing Hoops;* Emerson C. Strange, Taunton, Massachusetts.

Claim.—"1st, Making the saw of the peculiar form, being a plain circular saw, with a beveling or angular edge or rim, not confining myself to any particular angle which this rim makes with the saw plate, but using that which is best adapted to the work. 2d, The cam, the sliding journal box, the lever, and its connexions, the shield and the lever, and its attachment, so as to operate together."

85. For an *Improved Mode of Tightening Felloes in Wheels;* Augustus Stoner, Mount Joy, Pennsylvania.

Claim.—"The construction and operation of the metallic checks. Also, the manner of securing them in their place when applied to the felloes of wheels, by the use of melted metal of any kind, filling the grooves to keep them secure in their place."

86. For an *Improvement in Seed Planters;* Joseph Thompson, Durhamville, N. Y.

Claim.—"The spring plate, or its equivalent, so constructed and arranged as to hold the earth down firmly while the punches and tube are drawn out of the earth."

87. For an *Improvement in Corn Planters;* John S. Toan, Venice, New York.

Claim.—"The combination and arrangement for operation together, of the lower sliding tube, having a plough bit in front, and covering roller rigidly attached to it in the rear, with the secondary cross sliding valve and its operative, arranged to form part of said sliding tube—the whole being supported by the covering roller and plough bit, for the more perfect and easy operation of the secondary valve and sliding tube."

88. For an *Improvement in Locks of Fire Arms;* Alfred Tonks, Boston, Mass.

Claim.—"The arrangement or application of the spring rocker catch, the tooth of the trigger, and the shoulder, with respect to the striker, its arbor and the trigger, and so as to enable the striker to be operated."

89. For an *Improved Method of Adjusting the Size of the Mouth in Planes;* Thomas J. Tolman, South Scituate, Massachusetts.

Claim.—"The application to the common plane, of the screw attachment and key through the same, thereby regulating the mouth, and greatly increasing its value."

90. For an *Improvement in Reaping and Mowing Machines;* David Watson, Newark, New Jersey.

Claim.—"The use and application of the adjustable curved flat spring to the upper surface of the finger bar, when both are attached to the stirrup for joint action."

91. For an *Improved Screw-Feeding Gear;* Caleb C. Walworth, Boston, Mass.

Claim.—"The combination of a feeding screw or nut, arranged so as to have an endwise movement with springs, for the purpose of insuring the engagement of the screw and nut, and returning either of them to a mean position, when released from strain."

92. For an *Improvement in Power Looms;* Wm. Weild, Manchester, England; patented in England, March 7, 1855.

Claim.—"When applied to looms, or machinery for weaving pile fabrics, &c., the arrangement of the wires in grooves or flutes, formed in a roller or cylinder, the wires on being pushed into the 'shed' never wholly leaving the grooves in the roller or cylinder. Also, as a peculiarity and novelty, the arrangement of the wires, so that the one to be inserted in the shed is opposite, or nearly opposite, and in a line with the fell of the fabric, or that point where the reed will leave the wire on beating up such wires, having to be bent out of the straight line to present the points towards the widest part of the shed."

93. For an *Improved Method of Hanging and Operating Reciprocating Saws;* Carlyle Whipple, Lewiston, Maine.

Claim.—"The lever, two or more, when the upper lever or levers are attached to an adjustable shaft, and the levers, driven by a crank pin, having the rollers fitted upon it, and working within a slot in the lower lever, the saw being attached to the end of the levers."

94. For an *Improvement in Machines for Paring and Slicing Apples;* D. H. Whittemore, Chicopee Falls, Massachusetts.

Claim.—"So arranging the slicing knife, that it shall cut the apple into a contin-

ous spiral slice. Also, so combining the parer and slicer with each other, that the operation of the two shall be simultaneous."

95. For an *Improvement in Calendar Clocks;* M. J. Whitmore, Potsdam, Assignor to self and Frank G. Johnson, Brooklyn, New York.

Claim.—"The placing of the intermittent cogs upon the upper and lower faces of the calendar wheel, and the giving of said cogs the necessary movements for accomplishing the intended purpose, by means of the sliding, and stationary, and intermitting pinions on the shaft."

96. For an *Improved Method of Fastening the Rails of Iron Fences in the Posts;* John B. Wickersham, City of New York.

Claim.—"Connecting the bars, strips, or rails, that pass through mortises in corrugated metallic posts or bars, to secure said posts at the points of intersection."

97. For an *Improvement in Artificial Legs;* O. D. Wilcox, Easton, Pennsylvania.

"The nature of this invention consists in the peculiar introduction of elastic cords or muscles, with their conjoined tendons extending from the sound part of the limb, by which the motion of the leg and foot may be effected and controlled."

Claim.—"The artificial elastic muscles, with their conjoined tendons running from the thigh to the foot, to effect and to control the motions of the leg and foot, in case of amputation at the knee, and below it."

98. For an *Improved Method of Hanging, Guiding, and Adjusting "Muley Saws;"* A. Winter, Pickens, South Carolina.

Claim.—"1st, The arrangement of the clamp guide posts, in combination with the sliding head, for securing it in any desired position. 2d, The method of constructing the sliding guide head, with the face guards keyed on to starts framed into the sliding head, for the purpose of adjusting or removing them in case of wear. 3d, The arrangement of the boxes in connexion with the cross-head, for the purpose of adjusting the saw to give it the desired advance motion during its downward stroke. 4th, The arrangement of the guide posts and upright, in combination with the beam and sill, whereby the usual fender posts, &c., are dispensed with."

99. For an *Improvement in Oil Pressing Machinery;* Wm. Wilber, New Orleans, La.; patented in England, June 12, 1856.

Claim.—"Extracting or expressing the oil from tempered oleagenous seeds, or other vegetable matter, by pinching and carrying said tempered material between two belts or aprons, made of hair cloth, or similar heavy porous materials, and thus forcing it through between compressing rollers; and this I claim, whether the oil be cold pressed or hot pressed, or both, or whether used in connexion with a reducing apparatus or separate therefrom."

100. For an *Improvement in Stove Thimbles or Deck Irons;* Loftis Wood, City of New York.

Claim.—"The deck iron, irrespective of the mode or process of casting."

101. For an *Improved Method of Mounting and Guiding Circular Saws;* G. F. S. Wright, Black Oak, South Carolina.

Claim.—"The employment or use of the spring applied to the machine, in connexion with the shoulder on the saw arbor. Further, the guide arranged or connected with the saw and rotating wedge, when used in connexion with the spring."

102. For an *Improved Mode of Lathing and Plastering;* John G. Vaughan, Middleborough, Massachusetts, Assignor (by mediate transfer,) to Isaac M. Singer, City of New York.

Claim.—"Plastering ceilings, or other surfaces, on lathing formed and secured, so as to leave intestices between them, with parallel sides oblique to the surface of the plastering when put on."

103. For an *Improvement in Machines for Forming Hat Bodies;* Ira Gill, Walpole, Assignor to self and Elbridge Brown, Malden, Massachusetts.

Claim.—"The forming of a hat body within an inclosed chamber, in which a vortex is produced—said chamber diminishing in area from its open to its closed end, to regu-

late the draft through it, and to avoid counter currents, eddies, or dead space. Also, in combination with the cone on which the hat body is formed, a register or draft regulator within it, so as to regulate the quantity of fur, or other material, that is to be gathered upon its upper and lower portions."

104 For an *Improved Method of Planing Sashes;* Daniel Berlew, Delaware, Ohio.

Claim.—"The combination with the reciprocating carriage and frame, the hooked and slotted springs, or their equivalents."

JANUARY 20.

105. For an *Improvement in Guides for Sewing Machines;* Wm. B. Bishop, Brooklyn, New York.

Claim.—"An elongated pressure bar or foot, having therein a flat groove to receive the edge of the centre or button hole plait of shirt bosoms; and also, a straight bearing surface, forming the under and guiding surface for the other seams or plaits of shirt bosoms, whereby I am enabled to stitch continuous straight seams in shirt bosoms, at a rapid speed, and perfectly straight, without any care or help from the operator."

106. For an *Improvement in Machinery for making Paper;* John S. Blake, Claremont, New Hampshire.

Claim.—"1st, The employment or use of the pump, vacuum chamber, and vacuum chest, provided with two compartments, and communicating with the pipes by means of the cocks. 2d, The air and water trunk, or reservoir, provided with the pipe, and communicating with the external pipe—the reservoir communicating by means of a pipe, with the pipes having the tubes connected to them—the whole being arranged for the purpose of trimming the edges of the paper or pulp; and I further claim, trimming the edges of the pulp, by means either of air or steam, when ejected through tubes. 3d, The pipe with the tubes attached and arranged for the purpose of discharging the margin or strips of pulp from the main wire cloth apron. 4th, The curved rod, with the rollers placed on it, the roller being connected with the springs, whereby the felt apron is stretched or distended transversely, and also guided or properly retained in position as it operates. 5th, The cylinder, in combination with the wet press cylinders, when the speed of the cylinder and cylinders is made variable, for the purpose of stretching or distending the apron longitudinally."

107. For an *Improvement in Machines for forming Bats for Felting;* John H. Bloodgood, City of New York.

Claim.—"The combination of the rollers with the vibrating drum. Also, the combination of the rollers with the vibrating drum and the roller."

108. For an *Improved Centre-Vent Water Wheel;* E. G. Cushing, Dryden, New York.

Claim.—"1st, Making the bucket with a back of such a curve that it forms a space of regular contraction from the outside to the inside of the wheel. 2d, Hanging the buckets, combined with a spring, in such a manner that the discharge orifice is regulated by the quantity of water let into the scroll, and the amount of power required, and closing together when the gate is shut."

109. For an *Improvement in Artificial Teeth;* Alfred A. Blandy, Baltimore, Md.

Claim.—"Constructing artificial teeth, with a hole passing vertically through them, for the reception of the molten metal, and with a neck and projecting sides."

110. For an *Improvement in Sewing Machines;* James E. A. Gibbs, Mill Point, Va.

Claim.—"Making the chain stitch with a vibrating needle, in combination with a stationary hook."

111. For an *Improvement in Sawing Machines;* George Gregg, Lowe's Mill, Va.

Claim.—"The whole."

112. For an *Improvement in Sewing Machines;* Elias Howe, Jr., Brooklyn, N. York; patented in England, July 26, 1848.

Claim.—"Drawing the thread through the cloth by means of a finger, or its equivalent, acting in connexion with mechanism which passes the needle through the cloth."

113. For an *Improvement in Steam Pressure Gauges;* E. G. Allen, Assignor to Henry O. Allen, Boston, Massacuhsetts.

Claim —" The helical dome."

114. For an *Improvement in the Manufacture of Double Pile Carpets and Rugs;* John Goulding, Worcester, Massachusetts.

Claim.—" The fabric made or woven ; that is to say, by crossing the top ground warp once only, for two shoots of binding filling, one of which passes through and binds the pile warps, and crossing the ground warp of the bottom fabric, once only for four shoots of the binding filling, three of which pass through and bind the pile warp."

115. For an *Improvement in Treating Photographic Pictures;* John Bishop Hall, City of New York.

Claim.—" Producing in pictures to be seen by direct light, a high artistic and stereoscopic effect, by combining with a white light, or reflecting back ground, or its equivalent, two or more identical pictures of the same subject, rendered more or less transparent, and executed on, or attached to, plates of glass."

116. For an *Improvement in Grain Separators;* George Heberling, Quincy, Ill.

Claim.—" The arrangement in a grain cleaning machine of the plate armed with teeth, and rubbers, the conical cylinder with beaters and fans attached, chute or rim, plate, tubes, and fan."

117. For an *Improved Die for making Spikes;* E. T. Henry, Scranton, Penna.

" This invention consists in forming a lip or cutting edge at the point end of the die."

Claim.—" The lip, formed at the point end of the groove in the die."

118. For an *Improvement in Harvesters;* M. G. Hubbard, Penn Yan, New York.

Claim.—" The combined cutting standard and inclined track clearer. Also, hinging the cutting standard and track clearer forward of the finger bar, and near the front end of the shoe, and supporting the same against lateral pressure, by means of the fulcrum post."

119. For an *Improvement in Cutters for Harvesters;* M. G. Hubbard, Penn Yan, New York.

Claim.—" The cutter, when formed in one piece."

120. For an *Improvement in Machines for Paring Apples;* Jared O. M. Ingersoll, Ithaca, New York.

Claim.—" The peculiar form of the rod, operated by pins on the face of the wheel, in connexion with the transverse bar."

121. For an *Improvement in Blast Furnace;* Wm. Kelly, Eddyville, Kentucky.

Claim.—"The combination of the hearth of a blast furnace, with the auxiliary tuyeres, for delivering a blast of air into the fluid iron in said hearth."

122. For an *Improvement in Harvesters;* Pells Manny, Waddams' Grove, Illinois.

Claim.—" Connecting the leading board to the main frame, by means of the curved elastic shoe, rigidly attached at its front to the leading board, and at its back to the under side of the main frame by joints in rear of the finger bar, in front of the driving wheel, when said leading board serves to carry the fulcrum of the seat lever, by which the front of the main frame is raised and lowered. And further, the combination and arrangement for operation together, of the seat lever and foot lever or treadle."

123. For an *Improvement in Bridges;* D. C. McCullum, Oswego, New York.

Claim.—" So combining the arch brace with the arched cord or beam, the top horizontal surface of the abutment or pier, and the lower cord or tie, by means of the iron shoe and tension rods, as that the thrust of the arched cord shall be thrown down upon the abutment, and any deflection in the lower cord be counteracted by an upward force at each end of the tension rods. Also, the method of lengthening or shortening the braces of a bridge truss or girder, by which the truss may be elevated or depressed as required, by means of the yoke, the plate on the end of the brace, and the straining pieces with their nuts."

124. For an *Improvement in Winnowing Machines;* Joseph and James Montgomery, Baltimore, Maryland.

Claim.—"The application of an adjustable sieve above the auxiliary screen box, when arranged in combination therewith, in such a manner as to separate the large impurities before the grain is subject to the action of the blast, in order to render said auxiliary screen box more efficient in its action, and thereby allow it to be made as limited in extent as desirable."

125. For an *Improved Hydrant;* James G. Morgan, Brooklyn, New York.

"The nature of my invention consists in constructing non-freezing hydrants with a waste cistern, in combination with one or more air or gas chambers, in such a manner that by compressing a portion of the air chamber, the water in the cistern will be forced up and fill the discharge pipe, whereby I am enabled to construct non-freezing hydrants with the cock and all the machinery above the ground; also, in the peculiar manner in which the air chamber is compressed and released, by turning the handle of the cock."

Claim.—"The combination of a cistern to receive and retain the waste water of a hydrant, with one or more air or gas chamber or chambers, arranged in such a manner that by compressing the air chamber, the air therein will be forced into the cistern, thereby forcing the water in the cistern into the discharge pipe, and by releasing the air chamber from such compression, the water in the discharge pipe will run into the cistern; nor do I limit my claim to a flexible air chamber, as I consider a piston and cylinder a mechanical equivalent. Also, the peculiar method of compressing and releasing the flexible air chamber, in connexion with the opening and closing of the cock."

126. For an *Improvement in Brick Machines;* B. F. Nave, Roanoke, Indiana.

Claim.—"The peculiar manner of operating the sand gauge by means of bent levers, in combination with cross-bars and shields, when the above parts are constructed and arranged for joint operation."

127. For an *Improvement in Hose Coupling;* Lodner D. Phillips, Chicago, Illinois.

Claim.—"The combination of the sections of the hose coupling (having conical tubes on the exterior ends thereof), with the conical sleeves."

128. For an *Improvement in Reflectors for Vaults;* Emil R. Pichler, Boston, Mass.

"The nature of my invention relates to a reflector made of glass, and having double corrugations in it so made as to break up and soften the rays of light reflected by it, and shed a more pleasant and less glaring light into the vault, cellar, or other dark apartment."

Claim.—"The so arranging of the glass plates in a frame or frames, as to have the appearance and effect of double corrugations, when said plates are backed by any reflecting material."

129. For an *Improvement in Laying Tops for Cordage Machines;* Wm. Robinson, Assignor to self and Amenzo W. Beardsley, Warsaw, New York.

Claim.—"In laying tops, the use of a movable cone, or its equivalent, so constructed and arranged as to yield to the larger strand or strands, and be pressed by them against the smaller strand or strands; whether said movable cone is pressed against the strands by a spring, screw, or otherwise."

130. For an *Improved Machine for Bending Timber;* James D. Sarven, Maury County, Tennessee.

Claim.—"The bending frame, or its equivalent Also, in combination therewith, the mechanism and arrangement, or other equivalent devices, for the purpose of operating the bending roller, or its equivalent. Also, in combination with the bending frame, or its equivalent, the mechanism and arrangement, or other equivalent devices, for the purpose of bending timber in regular or irregular forms or curves, if the same is used in combination with a revolving mould, or mould operating or arranged in any other manner."

131. For an *Improved Method of Feeding Lumber laterally in Sawing Machines;* Samuel R. Smith, Florence, Massachusetts.

Claim.—"The combination of mechanism by which the lateral adjustment of the log is effected; such consisting of the spring, the stationary bearing roller, or its equivalent, the lever, the toggles, the slide bar, the catch mechanism, the pinion, and the rack

or racks applied to the carriage. Also, making the carriage or head block movable, independently of the ways or frame on which it is supported, and combining with said carriage and its movable rack, a lever and pawl, or an equivalent device, whereby said carriage may be moved towards the saw by the hand of an attendant applied to the said lever."

132. For an *Improvement in Cooking Stoves;* John G. Treadwell, Albany, New York.

Claim.—"As my invention and improvement in stoves with elevated ovens, having an escape flue below the elevated oven, and none above it, the construction and arrangement of the damper, so that by turning it in one direction, it shall compel the flame and smoke to pass around the oven, and by turning it in another, may shut off the flame and smoke entirely from the oven."

133 For an *Improved Machine for Bending Sheet Metal;* John Wright, Assignor to the S. Stow Manufacturing Company, Plantsville, Connecticut.

"This invention consists in the employment of an anti-friction plate, for the purpose of giving accuracy in the bending of the metal."

Claim.—"The plate."

134 For *Roofing Cement;* R. H. Smith, Cincinnati, Ohio.

Claim.—"A cement formed by materials, whereby a cement may be made and applied to roofing and other purposes, without the aid of fire to render it fluid, as heretofore, and by which the offensive smell arising from the use of coal tar, &c., is neutralized."

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135. For an *Improvement in Steam and Pressure Gauges;* John Allcroft and Thomas Mighten, City of New York.

"This invention consists in a certain arrangement of two or more elastic metal disks, which are deflected by the pressure of the steam or other fluid to be gauged, and thereby caused to give motion to an index."

Claim.—"The arrangement in pressure gauges of two or more corrugated elastic metal disks, at a distance apart, with an interposed ring or rings between their edges, and one or more central bearings between their centres."

136. For an *Improvement in Radiators for Fire Place Grates and Franklin Stoves;* Wm. Bennett, City of New York.

Claim.—"A perforated metallic plate or radiator, filling the fire place with a flanch of indefinite depth, and resting upon the fuel directly, or upon the top bar of the grate and against the fire back, in such a manner that the whole shall come below the flue of the stove, or throat of the chimney in which it is used, leaving the passage for the cold air to the chimney flue, free and unobstructed."

137. For an *Improvement in Stone Grooving Machines;* George W. Bishop, Brooklyn, New York.

Claim.—"A series of vertical inclined chisels of different lengths, placed one behind the other, in combination with a revolving hammer or cam, whereby I am enabled to give a positive motion to all the chisels from a single hammer for each series of chisels."

138. For an *Improvement in Machines for Shearing Sheep;* R. P. Bradley, Cuyahoga Falls, Ohio.

Claim.—"Increasing the length of the zigzags of the slot in the lever, as they recede from its fulcrum, so as to give the opposite end of the lever, which carries the teeth or blades, a uniform and equal motion as the pin is traversed in the slot."

139. For an *Improvement in Machines for Trimming Hedges;* Samuel Bradbury, Griggsville, Illinois.

Claim.—"The arrangement of the adjustable cutters and vertical cutters."

140. For an *Improvement in Speeders;* James S. Brown, Pawtucket, Massachusetts.

Claim.—"The device for dropping the spindle, arranged and operated substantially for the purpose of enabling the operator to remove the full bobbins, and insert the empty ones in their place."

141. For an *Improvement in Sash Fastener;* John Broughton, Chicago, Illinois.

"The nature of my invention consists in introducing a spring between the rib of the bolt, and the overhanging front plate of the socket."

Claim.—"The employment of a spring on the inner surface of the curtain *h*, of the socket."

142. For an *Improved Method of Inserting the Buckets in Shafts of Direct Horizontal Water-Wheels;* Tenison Chesher, Middleburg, Ohio.

Claim.—"The sliding buckets, combined with the mortises."

143. For an *Improvement in Corpse Preservers;* Samuel Cobb, Cincinnati, Ohio.

Claim.—"Providing the lid of the coffin with sides or edges, when arranged with the pipes at each corner of the lid and made to extend down into the pipes in each corner of the coffin, all for the purpose of confining the ice to the top of the lid, and drawing the water therefrom collected by the melting of the ice."

144. For an *Improvement in Calash Carriage Tops;* George and David Cook, New Haven, Connecticut.

Claim.—"The combination of the independent joints with the method of inserting the flat part of the shank or slat iron into the slot in the bow, and securing it there, so that the leather may be stitched, and the bows and shanks afterwards inserted and secured."

145. For an *Improvement in Rotary Brick Machines;* George Crangle, Philadelphia, Pennsylvania.

Claim.—"The pressing roller or small cylinder, having the recesses fitted with the coupled moving pistons or slides, so that as the surplus clay on the face of the partition which is next above the mould then forming a brick, is pressed into the recess of the roller by the said partition, the opposite piston shall thereby be caused to discharge the previously taken up clay, which is in the recess at the opposite side of the pressing-roller, the said pressing-roller being constructed and operating in combination with the mould cylinder."

146. For an *Improvement in Machines for Hulling Rice;* Lewis F. Currier, Portland, Maine.

Claim.—"The improvement in the construction and application of the wheel or wheels, to the endless trough, whereby advantages in skinning rice are gained, as specified, such improvement consisting in the dished wheel."

147. For an *Improved Clamp for Soldering Spectacles;* George N. Cummings, Hartford, Connecticut.

Claim.—"The use of the supporting strips, springs, and brick."

148. For an *Improvement in Grain Separators;* Michael De Camp, South Bend, Indiana.

Claim.—"1st, The combination of the flue with the flues and chamber, constructed and arranged for the purpose of separating light grain, cheat, &c., from still lighter substances by dividing the current of air. 2d, The construction of the fan, by combining with a disk attached to a rotating shaft, leaves fixed upon each side of the disk."

149. For an *Improvement in Tailors' Measures;* Lyman Derby, City of N. York.

Claim.—"The arrangement of the graduated rules for giving the outlines of the back and front of a coat, when said back and front rules are suspended upon the jointed rule."

150. For an *Improved Apparatus for Blasting Rocks under Water;* James B. Eads, St. Louis, Missouri.

Claim.—"In combination with the column of water over the rock, or other material to be blasted, a mortar or weight of greater specific gravity than the water, to act as an auxiliary in holding the blast to the rock."

151. For an *Improvement in Feed Boxes of Bee Hives;* Jeresiah D. Egleston, Canaan, Connecticut.

Claim.—"The platter and wire springs, in combination with the feed box."

152. For an *Improvement in Fastenings for Hames;* Henry A. Fowler, East Guilford, New York.

Claim.—"The cam, so arranged and operated with the shaft and cap (by means of a coil spring), that the cap will always adjust itself."

153. For an *Improvement in Machines for Fallowing Land;* Richard J. Gatling, Indianapolis, Indiana.

Claim.—"A series of spades, having a combined vertical, reciprocation, and spiral twist, through the agency of a system of cams and levers."

154. For an *Improvement in Repeating Fire Arms;* Heinrich Genhart, Liege, Belgium.

Claim.—"The combination of the rotating breech, with radial chambers for containing a series of charges, in combination with the sliding barrel, the rear end of which is fitted to enter the forward end of each chamber, when brought in line."

155. For an *Improved Vaccinating Instrument;* James W. W. Gordon, Catonsville, Maryland.

Claim.—"The application of the cup-shaped perforated rod, to the ordinary spring lancet."

156. For an *Improved Spring Lancet;* James W. W. Gordon, Catonsville, Md.

Claim.—"The providing the ordinary spring lancet with a sliding shield, having a movement from side to side."

157. For a *Process for making Illuminating Gas;* Robert Grant, Brooklyn, N. Y.

Claim.—"Passing the products of the destructive distillation of coal, and other substances, yielding carburetted hydrogen (gas) through fused metals, fusible at a low temperature."

158. For an *Improvement in Cutting Sheet Metal;* Samuel Hall, City of New York.

Claim.—"Making the scores in the stock of the shears, for the edge of the sheet metal cut to pass into, within or below the line or plane of the face of each shear blade, or cutter, and increasing them (the scores,) in depth as they extend from the cutters."

159. For *Mounting of Artificial Teeth;* George E. Hayes, Buffalo, New York.

"My invention consists in a certain mode of applying the platina connexions by which the teeth are attached to the plate and retained in place, whereby I am enabled to represent all parts of the teeth and gums of the natural shape and proportion; and also, to afford to the work when finished, greater power of resisting any strain in the mastication of food, or other ordinary uses of the teeth, than is afforded by any of the modes of applying the connexions generally used."

Claim.—"Providing the teeth severally with a groove in the base, for the purpose of receiving a wire frame, or its equivalent, with a wire or wires projecting from the base on each side of the said groove, for the purpose of serving as connexions with the plate and with the wire frame, thereby enabling the natural crown to be represented on both sides of the tooth, and dispensing with the ordinary backing. Also, the attachment of the teeth to a wire frame, when the said frame is employed in addition to a direct connexion with the plate and stayed to the plate by stays, to give additional stability and security to the teeth."

160. For an *Improved Machine for making Coiled Springs;* James Harrison, Jr., City of New York.

Claim.—"1st, The combination of a revolving mandrel, and two or more grooved rollers, arranged and operating together. 2d, The employment of an adjustable springing bed, or otherwise, in an equivalent manner, applying springs under, or at the back, of the roller carriage, for the purpose of enabling the rollers to accommodate their movements exactly to the longitudinal profile and varying diameter of the mandrel, and thus ensuring their proper operation."

161. For an *Improvement in Harvesters;* Moses G. Hubbard, Penn Yan, New York.

Claim.—"The mode of attaching the finger bar to the frame, by means of two flat springs, when the same are so constructed and arranged as to operate in relation to each other."

162. For an *Acoustic Article;* Edward G. Hyde, Irvington, New Jersey.

Claim.—"The vibrating diaphragm or artificial ear, applied to an acoustic instrument or ear trumpet."

163. For an *Improved Method of Constructing Fence Posts;* Frank G. Johnson, Brooklyn, New York.

Claim.—"The post, formed and constructed in combination with the keys and rails."

164. For an *Improvement in Raising Sunken Vessels;* John P. Jourda, City of New York.

Claim.—"The arrangement and combination of the floats, chains, and chair bill or stopper, and chain dividers."

165. For an *Improvement in Cotton Gins;* Edwin Keith, Bridgewater, Mass.

Claim.—"1st, Inclining the upper part of the grates, for the purpose of giving an endwise motion to the roll of unginned cotton in the hopper. 2d, The construction of a brush cylinder, with a chamber or aperture in the end or head of the same, into which a current of air is drawn through an opening in the side of the gin, at a little distance from the axis, and being deflected by the form and direction of the aperture or chamber, is finally discharged at the periphery of the brush, near the sides of the gin, thereby preventing any accumulation of cotton at the ends of the brush. Also, the peculiar construction of the brush cylinder head, whereby two separate currents of external air are received at the end of the open brush, one of which currents being received near the centre in a direction parallel with the axis, is allowed to diffuse itself throughout the interior of the brush, and thus augment its general centrifugal action; while the other current being diverted and finally discharged through openings more or less contracted near the ends of the brush, and at right angles with the axis, tends to prevent all accumulation of cotton at the ends of the brush. 3d, The setting the rows of bristles in the brush alternately at different angles with the radii of the brush. 4th, The improved method of confining the lags or wings into the heads of the cotton gin brush, by means of lips or flanches projecting from the brush head. 5th, The introduction of a slight current of air into the flue of the gin, through one or more openings in the mote board or bottom of the flue, for the purpose of facilitating the dropping of the motes or dirt in front of or through the mote board. 6th, The adjustable screw-rods, in combination with the sliding mote board, and extending outward to the front of the gin, near the ginner."

166. For an *Improvement in Keyed Harps;* Anthony Kuhn, Baltimore, Maryland.

Claim.—"1st, A sounding board and suspended bridge, in combination with a solid bridge arranged at a distance from, or beyond the sounding board, so that the strings, extend across an open space between the sounding board and solid bridge. 2d, Extending the strings one-half their length, or more, through an open space beyond the sounding board, so as to make the instrument produce sounds like a harp, instead of sounds similar to those of a piano. 3d, Arranging the hammers above the key-board, and making them strike the strings towards and opposite to the sounding board, near the suspended bridge, instead of near the solid bridge. 4th, Increasing the number of strings in an instrument having the properties of a harp, so as to make the flats and sharps, without the pedals used in the old harps, so as to dispense with the pedals for that purpose."

167. For an *Improvement in Compound Rail for Railroads;* Charles T. Liernur, Mobile, Alabama.

Claim.—"The combination of a two part compound rail for railroads, in which the head of the top rail and the lower flanch of the bottom rail are each left undivided; the head of the top rail not resting on the upper part of the vertical rib of the bottom rail, but supported alone by its own vertical rib, in such a manner that the upper part of the vertical of the bottom rail, can be used as a temporary rail during track laying, so that no deterioration resulting therefrom shall prevent the well fitting of both rails; and thus, also, giving to the top rail a support unaffected by the variations of dimensions occurring in the process of manufacture through the rapid wearing of the rollers, and the unequal heating of the iron."

169. For an *Improved Life-Boat;* Matthias Ludlum, Essex, New York.

Claim.—"I claim as a new article of manufacture, the life-boat."

169. For an *Improved Self-Regulating Wind-Mill;* John M. May, Janesville, Wis.

Claim.—"The arrangement of the devices which are connected with each other, for the purpose of regulating the velocity of the wind-wheel, and also for the purpose of controlling the wind-wheel, independently of its self-regulating properties."

170. For an *Improved Lathe Machine;* Joseph B. O'Key, Indianapolis, Indiana.

Claim.—"The arrangement of one or more series of cells, and their gauge stop, in the arcs of concentric circles, for the reception of the blanks, in combination with an oscillating knife or knives."

171. For an *Improvement in Cotton Presses;* M. L. Parry, Galveston, Texas.

Claim.—"The double geared nut, working in combination with a screw, and operated by one or more shifting pinions."

172. For an *Improved Ore Cleaner;* David Pollock, Lancaster, Pennsylvania.

Claim.—"The cylinder with adjustable bars, the perforated guard, the hollow perforated shaft, the perforated ledges, the arms and lifters, the adjustable traveling roller, for the purpose of crushing, washing, screening and cleaning ores, or other material, either wet or dry."

173. For an *Improved Writing Pen;* John F. Reeve, Richmond, Virginia.

Claim.—"1st, The so jointing together of the two pieces of rigid or non-elastic metal, or other material, that the same may form a pen, the required opening and closing of the point of which may be effected by the greater or less pressure of the said point on the paper, assisted by the springs and wedge, or equivalent device. 2d, The regulating spring, as applied to the cams."

174. For an *Improvement in Hernial Trusses;* Samuel S. Ritter, Philadelphia, Pa.

Claim.—"The combination of the springs, and, with the pad attachment."

175. For an *Improvement in Harrows;* Daniel W. Shares, Hamden, Connecticut.

Claim.—"The construction and arrangement of the series of teeth on the side bars, in relation to the said bars and to each other."

176. For an *Improvement in Axle Boxes;* Alfred E. Smith, Bronxville, New York.

Claim.—"Making metallic pipe boxes for carriage wheel hubs, with the two ends cylindrical or conical to fit the arm of the axle, when these two sections are connected and combined with the intermediate part, corrugated or fluted inside and outside, for the three-fold purpose of giving greater strength with a given weight of metal, to form a series of longitudinal oil cells all round the arm of the arch, and to form longitudinal ribs all around on the outside, to enter the wood when driven in, that it may be effectually held and bound in the hub."

177. For an *Improved Composing Stick for Printers;* Wm. T. Tillinghast, Dayton, Ohio.

Claim.—"The combination of the several devices, and their application in forming the composing stick."

178. For an *Improvement in Oil Cases;* Isaac Van Hagen, City of New York.

Claim.—"The double tube, the loose valve, and ventilator thumb-piece."

179. For an *Improvement in Core Boxes;* Abner Van Horn, City of New York.

Claim.—"The use of the compartments, when arranged in connexion with the lifts and flask."

180. For an *Improved Mode of Altering Flint Lock Fire Arms to Percussion;* James Noble Ward, U. S. Army.

Claim.—"Securing the cone seat upon the lock plate, and making the contact of said seat and the barrel."

181. For an *Improvement in Machinery for Stripping the Top Flats of Carding Engines;* George Wellman, Lowell, Massachusetts.

Claim.—"1st, The arrangement of the segmental gear with its rim, and the pinion with its notched plate, upon the vibrating arm or rocker frame. 2d, Constructing the segmental gear with its set rim, and the lifting and stripping cams, in one piece or cast-

ing. 3d, The double mangle pin, segment, or rim. 4th, The combination of the pinion and its notched plate, with the double mangle pin segment."

182. For an *Improvement in Machines for Forging Metal;* Elbridge Wheeler, Fettonville, Massachusetts.

Claim.—"1st, The combination and arrangement of the rolls, one of them being capable of motion to and from the other, and entirely within the control of the operater. 2d, The stationary guard, adapted to grooves in both the upper and under rolls. 3d, Prolonging the boxes in which the rolls run, for the purpose of straightening the work."

183. For an *Improved Clamping Machine;* Elbridge Wheeler, Marlboro', Mass.

Claim.—"Constructing the movable jaw in two pieces, and hinging them in the centre."

184. For an *Improvement in Nut Machines;* S. H. Whitaker, Cincinnati, Ohio.

Claim.—"The circular shears and rollers or dies, for cutting off the blanks, and smoothing their edges, the bar being grasped or held by the mandrel and bar, or any proper device. Also, the circular shears and rollers or dies, in combination with the fixed mandrel, punch, or rod, and reciprocating bar."

185. For an *Improvement in Mills for Tempering Oleaginous Seeds;* Wm. Wilber, New Orleans, Louisiana.

Claim.—"The arrangement of machinery by which oleaginous seeds, as they are being tempered, shall be subjected to the direct and indirect action of steam in their transmission through the machine, from the grinding to where it is taken, preparatory to its being pressed."

186. For an *Improvement in Machines for Hulling and Separating Cotton Seeds;* Wm. Wilber, City of New York.

Claim.—"1st, In combination with the runner and concave, a blast across the top of said runner, to carry the material to the spout or trunk, as soon as it rises to the top of the runner. 2d, In combination with the runner and concave, the trunk with its teeth or grooves, for facilitating the separation of the hulls and kernels. 3d, Hanging the sieve box by an eccentric to the end of the shaft of the runner, and by the plate to the frame, to give said sieve box its compound, vertical, horizontal, and end movement. 4th, The plate, with their dress arranged at the feeding-in point of the machine, and forming a portion of the breast of the machine."

187. For an *Improvement in Supporting Masts in the Decks of Vessels;* Thomas J. Woodworth, Salem, New Jersey.

Claim.—"Constructing the partner for the masts of vessels."

188. For an *Improvement in Seeding Machines;* Erastus D. Wooding, Dixon, Ill.

Claim.—"The spreading roller."

189. For an *Improved Door Spring;* A. F. Chatman, Assignor to self, and Jacob Pearce, City of New York.

Claim.—"A wire, doubled lengthwise on itself two or more times, so that it will form a spring by opposite forces, when enclosed in a cylinder or tube, and not otherwise, to be used as a hinge, in combination with the spring, or without the hinge."

190. For an *Improved Machine for Planing Hoops;* Sylvester Sawyer, Assignor to the American Hoop Machine Co., Fitchburg, Massachusetts.

"My present invention consists in certain improvements upon a machine for which Letters Patent were granted to myself, in connexion with Joseph Sawyer, for an improved hoop machine, on the 6th day of May, 1856."

Claim.—"1st, Giving the frame which carries the roll a play between the adjusting screws, and bringing the roll up to its work by the spring. 2d, The eccentric lever, graduated arc and spring, for the purpose of regulating the thickness of the hoop, and of forming the lap. 3d, The combination of the cutters, as arranged upon the reciprocating gate, in combination with the rest."

191. For an *Improvement in Fountain Pens;* Joseph C. Silvy, Assignor to Thomas J. Dobyns, New Orleans, Louisiana.

Claim.—"The employment of a separate or independent spring to the guide or stopper rod, for operation with it and the pointed fountain case or handle."

192. For an *Improvement in Operating the Valve of Steam Hammers;* P. L. Weimer, Lebanon, and Samuel P. Francisco, Assignors to Samuel P. Francisco, Reading, Pennsylvania.

Claim.—"The so arranging of the crank and the expanding levers, or the axes or trunnions of the hammer stock, as that they can be separately adjusted thereon, but at the same time worked with the rocking or rolling of the hammer shaft, for the purpose of regulating at any time the power and motion of the hammer, by or through the movement of the slide valve."

193. For a *Vermin Destroyer;* Welcome Whitaker, Assignor to Henry L. Palmer and Julius A. S. Kilton, Troy, New York.

Claim.—"The use of bellows and flexible pipe."

194. For an *Improvement in Machines for Paring and Slicing Apples;* Clarissa A. Hubbard, Executrix of Guy H. Hubbard, dec'd., late of Shelburne Falls, Mass.

Claim.—"The arrangement of the machine with its paring and slicing knives, in such a manner as to careen upon the joint."

Additional Improvement.

1. For an *Improvement in Harvesting Machines;* Robert J. Morrison, Richmond, Indiana; patented December 16, 1856, additional, dated January 20, 1857.

Claim.—"Allowing the roller to come against an elastic or yielding stop, when the machine returns to its position, after passing any irregularity in the ground, for the purpose of saving the machine from sudden jars."

Re-Issues for January, 1857.

1. For an *Improvement in Axle Box Rollers;* George W. Geisendorff, Indianapolis, Indiana, and Jacob C. Geisendorff, Cincinnati, Ohio; patented Feb. 6, 1855; re-issued January 13, 1857.

Claim.—"Giving a position, motion, or rotation to the lubricating roller, by the axle of the car wheel."

2. For an *Improvement in Moulds for Pressing Bonnet Fronts;* Whitten E. Kidd, City of New York; patented Nov. 28, 1854; re-issued Jan. 13, 1857.

Claim.—"The hollow metallic mould of the form required to give the complete form required for bonnet fronts, and provided with a mode of imparting to it the required temperature, and the nature of corresponding form, to make pressure by a motion in or nearly in the line of the axis, when the said mould and matrix are used for controlling the position of the strip."

3. For an *Improvement in Cleaning the Top Flats of Carding Engines;* William H. Walton, City of New York; patented December 9, 1856; re-issued Jan. 13, 1857.

Claim.—"Suspending the top flats or lays upon pivots in the centre of the ends, by which they can be raised out of the way of the adjoining flats or lays, to be turned by means of a rack working on pinion upon their pivots. Also, stripping the flats or workers by a rotating brush, so arranged that a card may in turn, strip the brush and return the stripping to the main cylinder. Also, the combination and employment of the 'lickers in' *c c' d d'* and worker *e*, and acting as worker and strippers."

4. For an *Improvement in Machinery for making Cord;* William E. Nichols, East Haddam, Conn.; patented Dec. 11, 1849; re-issued Jan. 20, 1857.

Claim.—"1st, Twisting or controlling the twist of the strands, while the main frame is revolving to lay them into cord, by causing an even faced wheel attached concentrically to, and revolving with the bobbin frame to travel over a fixed and smooth surface-friction, causing the frame to revolve. 2d, Revolving the bobbin frames on their own axes, to twist the strands at the same time that they are carried round a common centre, to twist the cord by rolling them on the surface of a stationary annular inclined track, towards the inner or outer periphery of which they can be adjusted to run, so as to vary the relative twist of the strands and cord. But I make no claim to the mere turning of the bobbin frames by friction, by any of the devices usually employed for similar purposes. 3d, The construction and arrangement of the centre stem or spin-

dle of the bobbin frame, whereby the yarns are collectively subjected to progressively increasing tension and twist from the commencement to the end of the process of laying them into the strand, whereby the latter is rendered smooth and regular in its figure and of uniform density and strength, and subjected to uniform tension while being laid into the cord."

5. For an *Improved Portable Steam Sawing Machine;* Samuel R. Wilmot, City of New York; patented Aug. 14, 1855; re-issued Jan. 27, 1857.

Claim.—"An independent portable steam sawing apparatus, and connected in such manner with the boiler for generating steam, that the steam sawing apparatus can be moved from tree to tree, or applied in different positions at different parts of the same tree, without moving the steam boiler, or breaking the steam connexion therewith."

DESIGNS FOR JANUARY, 1857.

1. For *Upright Stoves;* Abner J. Blanchard, South Reading, Mass.; dated January 6, 1857.

Claim.—"The design of the base or pedestal, the rings, door, and cap plate connected."

2. For *Ever-Pointed Pencil Cases;* John A. Knapp, City of New York; dated January 6, 1857.

Claim.—"Making the case in the form of a cannon provided with the beads."

3. For *Clock Case Boards;* Charles Chinnock, City of New York; dated January 6, 1857.

Claim.—"The configuration of the wreath and projecting scrolls."

4. For *Printing Types;* George Bruce, City of New York; dated January 6, 1857.

Claim.—"I call this new type double great primer copper-plate script."

5. For *Parlor Stove;* Samuel F. Pratt, Boston, Mass.; dated January 13, 1857.

Claim.—"The combination and arrangement of ornamental figures and forms."

6. For a *Cooking Stove;* N. S. Vedder, Assignor to Newberry, Filley & Co., Troy, N. York; dated January 13, 1857.

7. For *Cook Stoves;* N. S. Vedder, Assignor to Wolfe & Warren, Troy, New York; dated January 27, 1857.

8. For *Parlor Cook Stoves;* N. S. Vedder, Assignor to Wolfe & Warren, Troy, N. Y.; dated January 27, 1857.

Claim.—"The ornamental designs and configurations."

9. For *Railroad Car Stoves;* James L. Howard, Hartford, Connecticut; dated January 27, 1857.

Claim.—"The ornamental design and configuration of the top plate, of the bottom plate, and of the door."

FEBRUARY 3.

1. For an *Improved Attachment to Sewing Machines;* Elisha Alexander, City of New York.

Claim.—"Combining the mechanism of the guiding and conveying rollers with the mechanism operating a sewing machine, having an independent feed, in such a manner that the said rollers shall guide automatically the finished work away from the machine in a straight line, by revolving in opposite directions with a speed regulated by that of the machine."

2. For an *Improved Excavating and Dredging Machine;* Jonathan R. Anderson, Chicago, Illinois.

Claim.—"The so arranging of the dipper with a traveling carriage, as that they may be automatically moved in and out on the arms, for the purpose of ensuring the filling of the bucket where the material is to be excavated. Also, in combination with the lever, the sliding piece, the clutch bar, and pawl, with their several appliances, so that by a single lever the attendant has entire control of the machine."

3. For an *Improved Safety-Coupling for Railroad Cars;* Edward H. Anderson, Milford, Delaware.

Claim.—"The special mode of effecting the self-coupling and self-uncoupling, by the combined action of the following parts, to wit: catches bolt with its rounded end bolt, with its concave end, jointed arms, and spring catches or jaws."

4. For an *Improvement in Filing Saws;* A. M. Beardsley, Constantine, Michigan.

Claim.—"The two piles arranged as shown, and attached to the reciprocating bed plate, which works between guides on a movable or adjustable plate, the bed plate being operated by the lever, or its equivalent, and the plate by the lever."

5. For an *Improvement in Seed Planters;* Levi Beemer, Libertyville, N. J.

Claim.—"A combination of triangular seed boxes, located upon the sides of the drive wheel as specified, with the measuring keys operated by the cams to admit the seed into the depositing cups."

6. For an *Improvement in Couplings for Wagons;* Jacob Boyers, Grandville, Va.

Claim.—"In combination with the ordinary coupling pole of a wagon, the rod, bar, or pole, connected to the front axle, and passing through the bow or hounds and through the rear axle, for the purpose of causing the rear wheels to track after the front ones, and so that the two axles can be coupled shorter or longer, without in any way affecting the proper tracking of the wheels."

7. For an *Improvement in Lard Lamps;* J. S. Brown, Washington, D. C., Assignor to Joseph Kent, Baltimore, Maryland.

Claim.—"The bosse ring, in combination with the brush of wires."

8. For an *Improvement in Anvils;* Otis Brigham and Seth E. Brigham, Fitchburgh, Massachusetts.

Claim.—"Combining with the anvil the secondary movable grooved horn, and mechanism for confining the latter to the former."

9. For an *Improvement in Machines for Cleaning Cotton;* Francis A. Calvert, Lowell, and Charles G. Sargent, Westford, Mass.

Claim.—"1st, The above described arrangement of the cylinders, the guard, and the diaphragm, whereby the motes and dirt removed by the guard are thrown back upon the first cylinder. 2d, The grating beneath the brush, which takes the material from off the fine tooth cylinder when the brush is placed over the cylinder, whereby the fly is either again carded on to the cylinder, or is recovered upon the surface of the perforated cylinder, the dust all passing through this cylinder."

10. For an *Improvement in Window Blinds;* Alexander M. Cochran, City of N. Y.

Claim.—"1st, The fitting of the tenons in one side of the blind to oblique slotted mortises, and securing them all in place by a long rod or wire. 2d, Effecting the connexion between the slots and rods, by making the rods of metal tubing with slits providing ears, to enter the said slits and passing a wire through the tubular rods and the ears. 3d, The confining of the slats in a closed or open condition, by means of bail shaped bars, applied and operating as described, in combination with the notches in the backs of the rods."

11. For *Improved Adjustable Seats for Carriages;* George and David Cook, New Haven, Connecticut.

Claim.—"So constructing, attaching, and locating the seats, as to preserve the perfect symmetry of the carriage, whether it be used with one or two seats, without any necessity of securing the movable seat."

12. For an *Improved Machine for Cutting Veneers;* Peter Cook, Tonawanda, N. Y.

Claim.—"The swinging box or head formed of the plates, said box or head working over concave beds and cutters, when the above parts are arranged to allow the bolt to feed itself to the cutters by its own gravity."

13. For an *Improvement in Puddling Furnaces;* Jacob Green, Philadelphia, Penn.

"My invention relates to those furnaces used in the manufacture of malleable iron, technically termed puddling furnaces, and consists in constructing such furnaces with

any convenient number of openings in each of the side walls, and placing a fire place at each end of the furnace, as fully described hereafter, the object of my improvement being the economizing of space, fuel, labor, and the production of a better quality of iron."

Claim.—"The constructing of puddling furnaces with any convenient number of openings or working holes on each side, and a fire place at each end, the bed of the furnace being common to both fires."

14. For an *Improvement in Machines for Sowing Seed Broadcast;* George Hall, Morgantown, Virginia.

Claim.—"The combination of the hinged and adjustable dash board with the working fingers and exit openings, for the purpose of taking the grain from the hopper and scattering it broadcast."

15. For an *Improvement in Machines for Forming Felt Hat Bats;* Washington G. Hagaman, Philadelphia, Pennsylvania.

Claim.—"The combination of the flat rotary sieve with the deflector."

16. For an *Improved Gas Generating Apparatus;* James Hansor, Wandsworth Road, England.

Claim.—"The pipes and the dampers as combined with the retorts, operating for the purpose of readily ascertaining and regulating the progress of the operation of gas making."

17. For an *Improvement in Machines for Dressing and Polishing Stone;* David Hinman, Berea, Ohio.

Claim.—"The combination of the disks attached to hollow revolving shafts with the supporting and vibrating rods."

18. For an *Improved Shingle Machine;* William Huey, Columbia, Pennsylvania.

Claim.—"1st, The particular method of adjusting the knives within a cylindrical (or other shaped) case, that they may be made to rise and fall according to the thickness of the shingle or board. 2d, Attaching the sawing and planing machines in such juxtaposition as to operate automatically."

19. For an *Improved Fan Blower;* Chester P. Marshall, Worcester County, Mass.

Claim.—"The application of the fixed partitions in the conducting air tubes of fan blowers."

20. For an *Improvement in Boxes for Pise-work Walls;* Otis Needham and Wales Needham, New Haven, Connecticut.

Claim.—"1st, The construction of the box with the movable end plates fitting to grooves in the side plates, and with a roller at one end near the top, and another at the other end near the bottom, the one to run on the finished part of a course of work which is in progress, and the other on a finished course or on the foundation of the wall, to guide the box in a horizontal line, while the plates keep it from deviating laterally from a straight line. 2d, The plate applied and operating in combination with the other parts of the box, to produce window caps, mouldings, or projections."

21. For an *Improved Apparatus for Containing and Dispensing Syrup for Soda Fountains;* James R. Nichols, Haverhill, Mass.

Claim.—"The arrangement of a series of cans with their pipes and corks, whereby they may be simultaneously charged with compressed air by a single pump, and any one of them may be isolated from the others."

22. For an *Improved Cotton Seed Planter;* James F. Orr, Orrville, Alabama.

Claim.—"Combining an adjustable plate with the seed cylinder."

23. For an *Improvement in Corn Planters;* Samuel M. Perkins, Fort Hill, Illinois.

Claim.—"The seed chambers upon the shaft with radial depositing apparatus, in combination with the wheels and mechanism by which said wheels are adjusted relative to the shaft.

24. For an *Improved Machine for Grinding File Blanks;* Robert G. Pine, Newark, New Jersey.

Claim.— "1st, The reciprocating frame attached to the frame as shown, and having springs connected with it, when said frame is used in connexion with the grindstone and patterns. 2d, Attaching the frame to the levers, bars, and shafts having the roller upon it."

25. For *Improved Cultivators;* Norman W. Pomeroy, Meriden, Connecticut.

Claim.—"The method of working the valves by means of the spiral spring and elastic disk or bottom."

26. For an *Improvement in Sewing Machines;* Samuel F. Pratt, Roxbury, Mass.

Claim.—"The combination with the arm of the spring, the projections, the bent lever and its projection, or their equivalents, the same being to produce the motions of the feed bar. Also, moving the loop hook or looper diagonally up to and away from the needle. Also, effecting the movements of the hook at the proper times, that is to say, by means of the plate attached to the arm operating upon the arm of the looper."

27. For an *Improvement in Life Preservers;* Warran A. Simonds, Boston, Mass.

Claim.—"A life preserving float composed of separate and independent sectional chambers or air vessels, covered and surrounded upon all sides by exterior sectional floats filled with cork or solid buoyant material."

28. For an *Improvement in Ladies' Riding Saddles;* Robert Spencer, City of New York.

Claim.—"Placing the pommel or head back of the front edge of the bars and in a diagonal position, whereby I am enabled to depress it to give ease of position to the rider, without interfering with the horse's withers. Also, connecting the near or short horns with the tree, by a screw on the end fitted to a series of holes, so that its position relatively to the seat and pommel may be shifted at pleasure to suit the rider. Also, the arrangement of the stirrup leather, in combination with what is known as the Mexican bars, whereby I am enabled to make a secure ladies' saddle without the use of the points heretofore employed for embracing the sides of the horse."

29. For an *Improved Method for Joining Boxes, &c.;* James Stimpson, Baldwinsville, Massachusetts.

Claim.—"The joining of boxes, drawers, furniture, &c., by means of round tenons and mortises, and a half lap or secret joint."

30. For an *Improved Pump;* Ambrose Tower, City of New York.

Claim.—"The raised or projective seat, and ebb water way, when the water, &c., is discharged from the ebb water way below the surface of the top of the raised or projective seat; thereby allowing all foreign or heavy substances that flow over the seat to be instantly forced out; consequently, the valve at all times has free play, and cannot become choked."

31. For an *Improved Mode of Hanging Window Sashes;* William Webster, Morrisania, New York.

Claim.—"The constructing of window sash with holes on their inner face, in connexion with the holes and grooves."

32. For an *Improvement in Blast Furnace;* Henry Weissenborn, City of New York.

Claim.—"The mechanical arrangement of feeder, in combination with a surrounding gas chamber, with an open bottom placed above the furnace throat, whereby the gas is prevented from escaping from the throat of the feeder without being covered, and then forced into the gas chamber by the dense body of coal and ore always contained in the feeder, and therefore delivers a regular supply of gas which can be carried, descending to any heating furnaces placed on the bottom ground of the blast furnace, with the advantages as if applied on the top of it."

33. For an *Improvement in Brick Machines;* William Wood, Hartford, Connecticut.

Claim.—"Constructing the front of the press box with the front of the grate attached thereto, so that by means of slides and swing front, a portion or all of the front of both press box and grate can be raised."

34. For an *Improved Shingle Machine;* William A. Whiting, St. Louis, Missouri.

Claim.—"Giving an elastic bearing to its rest or to the boxes of the knife wheel, or to the equivalents thereof."

35. For an *Improved Stump Excavator;* Jason W. Wood, Washington Township, New Jersey.

Claim.—"The employment of the cams, in combination with the levers and the chains."

36. For an *Improvement in Brass Kettle Machine;* Mary A. Cannon, administratrix of John Cannon, deceased, Warran, Rhode Island, Assignor to the New York and Brooklyn Brass Company, City of New York.

Claim.—"1st, Elongating the handle of the tool into the lever to be operated by hand, when the said tool is moved up to the work. 2d, The arrangement of the shaft, whereby it is made to serve for the driving of the sliding bed, and also as a pivot, upon which the slide which carries the said bed is adjusted, thereby enabling the adjustment of the bed to be effected without affecting the driving gear."

37. For an *Improvement in Sewing Machines;* Joshua Gray, Assignor to self and John Gault, Boston, Massachusetts.

Claim.—"The combination and arrangement of the plate and slide, with their slots and pins."

38. For an *Improvement in Washing Machines;* Amos Jacobs, deceased, late of Ithaca, New York.

Claim.—"The combination of an oblique beater or dasher with a tub, constructed in such a manner that the stroke of the dasher or beater causes the tub or vessel to revolve, for the purpose of washing, cleaning, stamping, and rinsing clothes."

39. For an *Improvement in Accelerating Fire Arms;* Azel S. Lyman, Assignor to the "Accelerating Fire Arms Company," City of New York.

Claim.—"The employment of the accelerators or additional charge chambers. Also, covering the muzzle and exhausting the air through an appropriate aperture, whereby the atmospheric resistance is removed from the front of the projectile while passing along the bore."

40. For an *Improved Joiner's Plane;* J. F. Palmer, Auburn, New York, Assignor to S. W. Palmer, Detroit, Michigan.

Claim.—"The two plates and plane iron, arranged relatively with each other, and used in connexion with the screw rod and rod."

41. For an *Improvement in Operating Cut-off Valves of Steam Engines;* George H. Reynolds, Medford, Massachusetts, Assignor to self and D. B. Hinckley, Bangor, Maine.

Claim.—"Operating the cut-off valves in connexion with an ordinary slide valve, by the inclined sliding dogs, or their equivalents."

42. For an *Improvement in Pistols;* Wm. S. Butler, Assignor to Butler, Snyder & Co., Rocky Hill, Connecticut.

Claim.—"Constructing the pistol by casting the barrel, the frame or main part of the stock and guard, all in one piece."

43. For an *Improved Bridge;* Thomas W. H. Mosely, Covington, Kentucky.

Claim.—"1st, The compound arch. 2d, The saddle pieces, in combination with the stirrups and said compound arch. 3d, The sliding suspension plate, in combination with the cord and radial suspension rods."

44. For an *Improvement in Fastenings for Harness Hames;* Homer Compton, Wells Corner, Pennsylvania.

Claim.—"The combination with a hame of a spring bolt, a catch plate, and a spring plate."

45. For an *Improvement in Smiths' Forge;* John W. Crammel, Olivet, Michigan.

Claim.—"The use of two hollow sectional nozzle pieces, moving at right angles in a

two-way groove formed by the chamfered ribs, in combination with the two-wayed slotted opening in the hearth plate, formed and bounded by the stationary rims, and the chamfered corner block, whereby the moving nozzles can slide past each other, and form a continuous joint in any position."

46. For an *Improved Tool for Tenoning Spokes;* John J. Croy, Caledonia, Missouri.

Claim.—"1st, The employment of a tube for holding the spoke, while the tenon is being cut. 2d, The combination of an adjustable end piece or bed with the tube. 3d, The employment of an adjustable clamp cutter head."

47. For an *Improvement in Shirt Bosom Studs;* John P. Derby, Cavendish, Vt.

Claim.—"The side pieces, passing the one above and the other beneath the cross-piece, forming a double coil and double lock."

48. For an *Improved Machine for Cutting Tenons on Blind Slats;* Seth C. Ellis, Albany, New York.

Claim.—"The arrangement of the rotating disks, with their slots disposed in reference to, and in combination with, the saws, for the purpose of regulating the revolution of the slat, so as to direct the saws in cutting perfectly cylindrical axes or tenons to it. Also, the feeding apparatus, to wit: the sliding box, disks with the wheels lying within the jaws, and the lever with the eccentric, acting together, and in combination with the disks and saws."

49. For an *Improved Self-operating Device for Tilting Buckets in Raising Water from Wells;* Daniel P. Farnham, Milton, Wisconsin.

Claim.—"The fastening formed of the rods attached to the cross-pieces of the links, and the loops on the buckets, in combination with the pendent or swinging-rod, placed within the framing or curb."

50. For an *Improved Hydrant;* Wm. Fields and Solomon Gerhard, Wilmington, Del.

Claim.—"1st, The combination of the lever with the rods operating the plungers. 2d, The plunger valve, when arranged in relation to the bent pipe, and when operated in connexion with the plunger, and not otherwise."

51. For an *Improvement in Forging Gun-lock Springs;* George P. Foster, Bristol, Rhode Island.

Claim.—"Operating the rolls by means of the cogged segment, wheel, and spring."

52. For an *Improvement in Shaker Bars for Stove Grates;* George W. Gardner, Troy, New York.

Claim.—"The shaker bar, with the fulcrum, or its equivalent, for the purpose of revolving the grate without the usual slot in the stove, and confining the ashes in the stove."

53. For an *Improvement in Machines for Sowing Grain Fertilizers;* J. C. Gaston, Reading, Ohio.

Claim.—"The arrangement in machines for sowing grain and fertilizing materials, of a reciprocating feed bar at the required distance from the bottom of the hopper, for equalizing the supply of grain or fertilizing substance to the escape valve, and securing the said bar, hooks, or slides, by which the grain or compost is agitated and caused to escape, either in a continuous supply or at intervals."

54. For an *Improvement in Seed Drills;* Oliver C. Green, Worcester, Illinois.

Claim.—"The arrangement of the oscillating armed disks, concave, and guide ways, in combination with the aperture of the hopper."

55. For an *Improvement in Cotton Gins;* Lewis S. Chichester, Assignor to Henry G. Evans, City of New York.

Claim.—"1st, The employment or use of the vibrating feeder-plate, having a movement towards and from the bite of the rollers, and provided with the curved ledge at its upper end, the said ledge being serrated or provided with teeth, and placed at or near the bite of the rollers. 2d, The feeder plate, with ledge attached, in combination with the plate or comb."

MECHANICS, PHYSICS, AND CHEMISTRY.

*Hearder's Induction Coil.**

We are enabled this week to lay before our readers some further particulars respecting Mr. Hearder's improvements in the Induction Coil, together with some of the circumstances which led to them, and we have the more pleasure in doing this, as we gather from some remarks in a recent paper published by Mr. Hearder, that he refrained from giving early publicity to his improvements, in consequence of having confided the particulars to a friend who was about to publish a work on Electricity, which, however, has not yet appeared. We rather doubt the correct policy of this course, as it might have subjected him to the chance of being anticipated by others, who, hearing of his success in some casual notices of his labors, which appeared in the early part of this year, might have had their attention drawn to the subject; and we are not quite sure that this may not still be the case.

Mr. Hearder stated, in a paper which was read by him, to the Members of the Plymouth Institution, and Devon and Cornwall Natural History Society, in March of the present year, that his attention was first drawn to the subject, by hearing of some remarkable experiments made by Prof. Grove, with a new kind of induction coil, manufactured by M. Ruhmkorff, of Paris. Having, however, learned, on inquiry, that the precise arrangement of the machine was, from the mode of its construction, enveloped in secresy, he proceeded at once to act upon his own experience, and constructed an apparatus, with all its elements distinct from each other, so as to be able to examine the function of each individual part, and ascertain the effect of modifications of any of its parts. About the middle of last year he had so far satisfied himself on the best mode of procedure, as to have arranged the different elements in such a relation to each other as to develop an extraordinary amount of statistical tension in the induced current, and he proceeded at once to experiment with this arrangement. Many of his scientific friends were cognizant of his labors, and watched them with interest. Although Mr. Hearder had thus completed his machine in the latter part of last year, he had not proceeded far enough with his investigations to be able to bring them before the public until March of the present year; but, nevertheless, he has the merit not only of being the first to construct a successful statical induction coil of this kind in England, but of having in his first attempt far surpassed the most powerful productions of the French manufacturer.

There are some peculiarities in the construction of Mr. Hearder's instrument which are worthy of particular notice, because they appear to us not only to be important advantages over M. Ruhmkorff's arrangement, but serve to indicate the correctness of the principles by which Mr. Hearder has been guided. In M. Ruhmkorff's apparatus, one part is, as it were, built upon another, and every part so thoroughly imbedded in melted shell-lac, that it would be an exceedingly difficult matter to

* From the Lond. Mech. Mag., Dec., 1856.

unwind his coils to repair accidents, or to examine any alteration which may have taken place in its internal conditions. Since the power to be developed by these machines must greatly depend upon the perfect character of the system of insulation, and since there is a possibility of straining this point so far as to occasionally break down insulation even of a very perfect kind, Mr. Hearder has so contrived his apparatus as to be able to take any portion of it asunder, and thereby repair any accident that might occur from misuse or otherwise.

The first machine constructed by him consisted of a wooden bobbin lined with gutta percha, about six inches long in the clear of the ends, and having a hollow centre large enough to receive a primary coil with its included iron core. Upon this bobbin about a mile and three-quarters, subsequently reduced to a mile and a half, of secondary coil were wound, consisting of fine copper wire well covered with silk, and carefully varnished with shell-lac, which was allowed to dry previously to laying on. The layers were separated from each other by thin gutta percha or oiled silk. The interruptor was a very stiff spring, vibrating against a contact screw, and actuated by the end of the iron core, on the same principle as the spring of the medical coil machines. The condenser is in the base of the instrument, the coil is also furnished with a commutator for changing the direction of the current. This little apparatus, the bobbin of which is about half the length of that of M. Ruhmkorff, and the secondary wire about one-third in quantity, gave static sparks more than an inch in length in free air, and communicated such a charge to Leyden jars as to enable Mr. Hearder to make the discoveries detailed by him in a recent paper in the *Philosophical Magazine*. Since the construction of this first machine, Mr. Hearder has made a second of extraordinary power. The bobbin is 12 inches in length, and the secondary wire rather less than three miles, but, with these exceptions, the other arrangements of the apparatus are the same as in the smaller one. The length of statical spark developed by this machine, with twelve cells of a nitric acid battery, the platina plates of which are 2 ins. by 4 ins., is nearly 3 ins. in free air, and it readily produces a spark of more than 12 inches in length through the flame of burning alcohol. With it, some new phenomena have been developed, and others which have hitherto been deemed peculiar to the induction coil, have been found to be peculiar only to its mode of construction and comparatively feeble energy; for instance, with Ruhmkorff's machine, the terminal only, which proceeds from the outer end of the coil, gives static sparks to an insulated neutral conductor, whilst that proceeding from the inner end, gives no sparks, and may be handled with impunity. When the current passes between the ends of fine platina wires, the negative electrode only is heated, whereas in Mr. Hearder's machine, both the inner and outer terminals give strong static sparks which are insupportably painful, and at certain distances both positive and negative terminals are not only heated but melted. Such effects as these, obtained with a single machine, have never before been heard of; but in a recent paper in *Les Comptes Rendus*, M. Foucault states that he has succeeded in obtaining a spark of nearly 3 ins. in length, by the combined effect of four of M. Ruhmkorff's machines, but that, in order to work them in series,

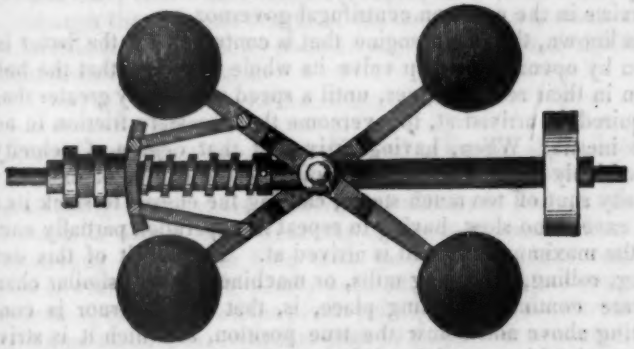
it was necessary to have them peculiarly constructed, as the secondary coil was not otherwise sufficiently insulated. Now, when it is considered that the united length of wire in these machines was probably not less than twenty miles, and when we find that Mr. Hearder has produced an equal effect with a single machine, containing less than three miles, there can be very little doubt that his instrument is based upon much sounder principles, and the success already attained, warrants us in believing that much more will be speedily accomplished.

For the Journal of the Franklin Institute.

Notice of a Marine Governor. Invented by THOMAS SILVER, Philadelphia.

Communicated by the Inventor.

The regulation of the speed of steam engines, under circumstances of various resisting loads, or different degrees of pressure of steam, has afforded a subject for experimental mechanical philosophy, until facilities for effecting that desirable object have been arrived at, that are very nearly satisfactory for the stationary engine, except in extreme cases; but heretofore, although subjected in rough seas, to much greater violence from waves, suddenly receding from the wheels, or the tossing to and fro of the ship, no efficient plan has been adopted for the regulation, in limitation, of the motion of the marine engine.



Unlike the marine, the stationary or manufacturing engine, in practical use, is throttled down to a medium or average, of about half the pressure in the boiler that supplies the force, the marine engine is supposed to be driven with all the power that the boilers can generate, when in an unguarded moment, by reason of the pitch of the ship, or variable surface of the ocean, the wheels become relieved from the water, and commence flying around rapidly, in which case, it is clear that, should the ship roll, and one wheel become suddenly plunged into the water, that the other must serve the purpose of a fly-wheel, which, aided by the whole force of the engine will, unless great strength prevent, twist off a shaft, or strip some floats from the submerged wheel, at the same time, a wasteful flow of steam occurs, which overheats the condenser, and the violence of the action, exerts a serious effect upon the journals and other parts of the machinery.

We here then, see, the need of a governor, that shall not only be entirely unaffected by any sudden temporary changes of position, but be extremely quick in its action.

The above cut illustrates a plan of instrument, invented by Thomas Silver, of this City, and patented in the United States, and also in several European governments, in 1855, and has been tested upon the United States Mail Steamship *Atlantic*, and others, with complete success.

It will be observed, that its principle of action is similar to the ordinary pendulum governor, except that it is entirely unaffected by the force of gravity, the two balls, as used in the ordinary governor, are in the present case balanced by two corresponding balls of equal weight, and placed at equal distances from the axis of motion; the resistance to the centrifugal force being attained by the use of a spiral spring, the tension of which can be altered at pleasure, by moving the collar that is nearest the centre of the instrument, up or down upon the spindle, and staying it with a set screw. This forms a ready means of adapting the powers of the governor to the desired speed of the engine, without the calculation necessary in adjusting the two balled governor, and as it is perfectly balanced, it can be placed in any position to suit circumstances. Thus, if horizontally, it requires no bevel gearing, as only a common pulley or band wheel placed upon the spindle, as shown in the engraving, is necessary.

In practical use, it is found to overcome the serious fault of vibration that exists in the common centrifugal governor.

It is known, that if an engine that is controlled by the latter is set in motion by opening the stop valve its whole capacity, that the balls will remain in their resting places, until a speed sufficiently greater than what is required is arrived at, to overcome the necessary friction in addition to the inertia. When, having arrived at that degree of velocity, they rise suddenly to a plane, corresponding to the degree of excess, and of necessity shut off too much steam, causing the engine to slack its motion to an excess too slow, having to repeat the operation partially each way, until the maximum of speed is arrived at. The result of this defect in driving, rolling, or sawing mills, or machinery where similar changes of load are continually taking place, is, that the governor is constantly vibrating above and below the true position, at which it is striving to arrive, and seldom attaining it before again being disturbed.

But in the marine governor the balls or centrifugal weight are exempted entirely from the arbitrary effects of gravity, and the spring which resists the centrifugal force thereof, plies its tension softly at the commencement of motion, but gathering force as the speed increases, checks and retains the engine at the desired velocity.

The well know defect in the old governor, has induced the invention of many ingenious forms of throttle valves, to remedy the evil. But the inventor of the marine governor claims, that plan of valve as the best, which is the most simple and plain in construction, having regard only to being steam-tight when closed, and opening with easy movement to the full capacity of the engine to receive steam, to which it is attached.

In corroboration of this theory, we would say, that in substituting the old governor with the marine, no attention has been paid to changing

the valves, although the defect, in some cases, was supposed to have existed in them.

It is now in use upon the engine of the United States Mint, that drives the rolling mills, where it works an admirable plan of puppet valve designed by Franklin Peale, Esq. This plan of valve, on account of its abruptness in opening and closing, no doubt favored the vibrations of the former governor, the frequent clashing of which, against the extremes of the guides, was unpleasant to the observer, but the quiet promptness with which the contingencies of rolling metals are met under the present arrangement, must afford a pleasure to the mechanical connoisseur.

It is also in use upon the engine of the *Public Ledger* printing office, where it works a Judson valve, the openings of which are made in a conical form as an offset to the irregular powers of the old governor. This valve has been worked both ways by it. It was applied first to open the small end of the cone, which is said to be the correct way, but for greater convenience of connexion, the crank was subsequently placed upon the opposite side of the valve stem, which reversed the opening to the large end of the cone. No difference in effect was discovered, but it gave perfect satisfaction either way.

It is also on the engine of the *New York Tribune*, working a common butterfly valve with equal result.

It is also in operation in every position, *i. e.* horizontally, perpendicularly, and in fact, otherwise; for in consequence of small and ill-shaped space, although the extreme length of the arms of the governor is only sixteen inches, it is necessarily placed upon the engines of the Steamer *Caledonia* in an inclined plane.

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*On Recent Improvements in Water Metres.** By Mr. T. T. Jopling.

[Read before the Institution of Civil Engineers, Dec. 2, 1856.]

After alluding to the generic merits and defects of piston and bucket metres,—merits which were generally appreciated, and defects which were apparently inseparable from these machines, and had only as yet been partially removed,—the author proceeded to describe a metre of his own invention constructed on the piston principle, which appeared to meet the objections hitherto made to that class of metre. It consisted of two measuring cylinders, set parallel to each other, with working pistons,—the rods of which projected out of the cylinders in opposite directions, carrying at their extremities slide valve frames, for supporting and operating on the slide valves that governed the ports of the cylinders. These measuring cylinders were contained in a cast iron case or tank, into which the water to be measured entered under a certain pressure. The water thence passed into the cylinders, from which, after having acted upon one or other of the pistons, it made its escape. Through the agency of suitable counting apparatus connected with one of the piston rods, the reciprocating movements of the piston were counted, and thus the quantity of water passed through the metre, in a given time, was indicated. The measuring chambers were made somewhat like ordinary steam engine cylinders, as respected the inlet and outlet ports; but in one of the

* From Newton's Lond. Journal, January, 1857.

cylinders the direction of the inlet ports was inverted, in order that the right hand port might pass the water to the left hand end of the cylinder, and the left hand port to the right hand end. By this means the two pistons were enabled to follow each other in the same direction, and to maintain a continuous stream of water, without the use of cranks. The slide valves were pressed up against the ports of the cylinder, by means of springs, in order to retain them in contact with the faces when the metre was at rest. They were free to remain stationary during the greater portion of the progress of the pistons; but just as the piston of one cylinder was completing its stroke, one of a pair of tappets on the valve frame, carried by the piston rod of that cylinder, would strike against the valve which that valve frame carried, and altered its position over the ports of the other cylinder, whereby the direction of the flow of water into that measuring cylinder was reversed. For transmitting the reciprocating motion of the piston to the index, one of the valve frames was furnished at the back with two ribs, or feathers set parallel to each other, but one in advance of the other. These feathers acted as teeth, and in sliding backwards and forwards with the piston rod, they entered alternately the teeth of an escape-wheel, and so drove it round tooth by tooth. The arbor of this wheel led through the water case to the counting apparatus; and thus motion was communicated directly to it, without the aid of pawls and ratchet-wheels.

By this arrangement the metre became a very simple and inexpensive machine, not liable to derangement; or if injured, it was easily repaired, as the only moving parts were the two valves and two pistons. There was an entire absence of concussion; the pressure of the head was preserved, and being similar within and without the cylinder, there was no friction upon the pistons; and the water-tight external case or chamber served as a deposit for sand or other extraneous matter. These merits were admitted by the engineer of the Sunderland Water-works, where the metres had been connected with metres by other manufacturers, and exhibited identical results.

Models of Jopling's, Kennedy's, Siemens', and Chadwick's metres were exhibited in action during the evening.

In the course of the discussions, descriptions were given of Kennedy's, of Chadwick's, and of Siemens' metres. The former was described as consisting of a single vertical cylinder, wherein a deep piston worked, with a packing, consisting of a vulcanized india-rubber ring, made to roll between the piston and the cylinder, allowing for easy motion, and yet being perfectly water-tight without friction. The alternate action of the piston was communicated to the counting apparatus, by means of a rack and pinion, and action was given to the inlet and outlet valves, by means of a tumbling weight. This machine, it was contended, was very durable, and easily kept in order; the elasticity of the packing, and the peculiar rolling motion, diminished the friction; the pressure of the water was preserved through the metre; the action of the valves was regular and simple; and under the most extreme trials, the variation had never been found to exceed one per cent. The metres were stated to have been extensively employed and much approved by water-works' engineers.

Chadwick's new metre was described as consisting of three or more rollers, revolving on their axis, attached to the periphery of a wheel, the spindle of which worked in journals in two upright supports; these rollers rested upon a bag or piece of prepared leather, with inlet and outlet passages, and so fixed upon a concave bed-plate of brass, as to form the measuring chamber of the metre. The water being admitted to the bag, propelled the rollers forward, so that they each in turn passed over every part, and expressed the fluid before them by the outlet pipe. The motion was regulated by a governor, moving in an opposite direction to the rollers, and the counting apparatus was identical with that in the old metre, described on a former occasion at the Institution. These metres had not been very long in use; but, as far as could be at present seen, they might be called successful.

Siemens' metre was of the class termed "inferential" measures, and so many of them were in use that it was not considered necessary to give any minute description of their construction, beyond stating that its action was similar to that of the Barker's mill—the water entering at the centre, and being expelled through numerous curved orifices at the periphery of the revolving metre.

It was contended that the chief desiderata for high pressure metres were—accuracy of measurement under very varying pressures; free passage for the water without loss of pressure; compactness and lightness of construction; with durability and cheapness.

Good metres were made both of the piston and diaphragm class, and many did register excellently during the laboratory experiments and for short periods; but the real test was the action after twelve months' constant work, and it was generally found that some injury had occurred to piston metres, from the introduction of sand, or other extraneous matter, whereas the action of the differential metres was as perfect, after several years, as when first they were erected. Arguing that a certain force was required to cause motion, it had been stated that these metres were not capable of registering small quantities of fluid at low velocities. This was, however, an erroneous opinion, in proof of which it was mentioned, that a small house metre had registered accurately so small a quantity as half a gill per minute. These metres gained in sensitiveness as they worked, —whereas piston and other metres were liable to wear and tear; the former could be so applied as to present little more resistance than a bend in the pipe; they were so compact in form, and so small, that they could be adapted to almost any situation, however restricted; and under either high or low pressure, and with constant or intermittent action, they had been found to give satisfactory results.

It was stated, that the East London Water-works Company had two hundred of Siemens' metres now at work. They had cost, on an average, £10 a-piece; but few failures had occurred, and those quite capable of being remedied, so that casualties were likely to be even less frequent in future. They were also almost exclusively used at Bristol, where they were tested every three months, and it had been observed, that they gained from 1 to 2 per cent. The new metres were consequently adjusted so as to allow for that gain.

It was admitted that both Jopling's and Kennedy's metres had, when

tested, been found to act very satisfactorily, and that, practically, they could be received as very good efficient machines, both for the water companies and the consumers.

It was shown, that there had been at least eleven distinct classes of metres, and probably not less than ten varieties in each class, which could be taken as one hundred and ten distinct inventions. They might be divided into two great classes;—high pressure metres, *i. e.*, working under the direct pressure of the mains, and delivering the water without any sensible diminution of the pressure; and low-pressure metres, which receiving the water under pressure, merely delivered it into a cistern, or other receptacle, generally situated at the top of the building to be supplied. The latter class was asserted to be generally the best, especially in those cases where the consumption was large and irregular,—as that of brewers, dyers, bleachers, calico printers, &c. Of this class, Parkinson's was said to register accurately under all circumstances of change of head, and velocity or quantity delivered. The piston, diaphragm, puff-bag, and screw-metres, were then successively described. In reference to Siemens' metre it was asserted, that it was in principle simply a turbine, or a Barker's mill, and that it partook of the errors of those machines, which no superiority of manufacture, or skill in invention, could entirely overcome. It could not register so small a quantity as would not give impulse to the machine. It had also been remarked that in some situations, it was liable to become co..oded, which materially lessened the speed, and that, in some instances, the metres had actually been stopped.

Explanations were given of the cases of objections to Siemens' metres, and the question was announced to be further treated on a future occasion.

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*Astronomical Expedition to the Peak of Teneriffe.**

Prof. C. Piazzi Smyth, the Astronomer Royal for Scotland, has returned from his astronomical expedition to Teneriffe, which was undertaken with the sanction of the Lords of the Admiralty, chiefly for the purpose of ascertaining how much astronomical observations can be improved by the elevation of telescopes into the higher regions of the atmosphere. In order to facilitate the inquiry, Mr. Robert Stephenson very liberally gave up to Prof. Smyth the entire use of his fine yacht, *Titania*, and its crew of sixteen men, for the whole period of the expedition. The loan of instruments of value by the Astronomer Royal, Mr. Pattinson, of Newcastle, Prof. Stokes, M. Gassiot, Mr. Nasmyth, Captain Fitzroy, Dr. Lee, and Admirals Beechey, Manners, and W. H. Smyth, also contributed greatly to the success of the expedition.

From the date of the sanctioning of the expedition by their Lordships, Prof. Smyth was closely occupied in preparing the necessary instruments (signally assisted in some of the more difficult parts by the Astronomer Royal), until the 20th of June, when he embarked on board the yacht, *Titania*, at Southampton, with about seventy cases of instruments and materials. After a prosperous voyage, during which he was enabled to accomplish, by novel, mechanical, and optical contrivances—namely,

* From the Lond. Mech. Mag., October, 1856.

his "free revolver stand" and "spontaneous horizon point"—two important desiderata of nautical astronomy noted in the "*Admiralty Manual of Scientific Inquiry*," and to ascertain the necessity of a new but large correction for marine barometers, he cast anchor at Santa Cruz on the 8th of July. On the 10th he proceeded overland to Orotava, the real port of the Peak, while the yacht went round by sea to the same place, and landed all the packages, as well as her carpenter and second mate, who were to serve as assistants on the mountain.

To determine neatly and definitely the question above mentioned as the chief subject of the expedition, in the style of a problem in pure mathematics, three stations should have been chosen; one at the base, the second half-way up, and the third at the summit of the Peak; and such had, in fact, been recommended. Prof. Smyth was prepared, therefore, to set up his instruments at Orotava as the first station; but finding that this town, and all that part of the country, were under continual cloud, thick, dense, and determinedly constant, he soon turned his attention to a higher station. He gave the preference to Guajara, a mountain 8870 feet high, on the south of the Peak, and on the 14th of July started for this place with twenty-seven horses and mules, and nearly all his baggage. Not the whole of it, for the very untoward circumstance had just been discovered that the form, size, and weight of the boxes of the great Pattinson equatorial were entirely unsuited to the means of transport in the country. He was, therefore, compelled to leave them behind, provisionally, it was hoped, while he was acquiring experience of the country, and of the astronomical qualities of the atmosphere with the smaller and more portable Sheepshanks equatorial of the Edinburgh Observatory.

Traveling, then, with his cavalcade, he began to ascend the long slope above Orotava, on a densely clouded day; but, after some hours, he had penetrated and finally risen above the clouds, the cumuloni of the north-east trade wind, at the height of above 5000 feet. This was immediately a realization of one of the astronomical advantages of elevation; for the sun now shone out hot and clear from a dark blue sky, unspecked by a particle of vapor—a state of things, too, which the characteristics of the plants and the dryness of the soil he was entering on, proved to be the rule and not the exception of that upper region. Finally, ascending through a pass in the southern wall, he and his party climbed the hill of Guajara, encamping that night among the trachyte and pumice blocks with which its summit is strewed. The morning showed that they were on the highest point of land in the island, except the Peak itself, which rose about three miles to the north of them, thus leaving the horizon clear east and west, where some of their observations were to be made. But, the site being open and exposed to every wind, and with a deep precipice, part of the old crater wall running along the northern side, their first exertions were directed to securing the station by building stone walls about the tents. To this end they procured native assistance, and erected also an optical room, a meteorological shed, and a telescope enclosure.

In astronomy, the admirable purity of the atmosphere and the advantage of an ascent of 8870 feet, were night after night proved by the

limit of vision of the Sheepshanks telescope, being extended from stars of the 10 deg. magnitude to those of the 14 deg. at Guajara, and not only the brightness of the stars, but their definition also was much improved; "for, while in Edinburgh," says Prof. Smyth, "I had never seen good images of stars in that instrument, on Guajara it almost always exhibited such clean and perfect stellar disks and rings as I have never seen in any other telescope at or near the level of the sea;" and while he was still on the mountain, with almost every night perfectly clear, and in general with enchantingly fine definition, the perception of these advantages was intensified by the arrival of a letter from the first assistant astronomer of the Edinburgh Observatory, saying that there had hardly been a single clear night there during all the time the Professor had been away.

The conclusion derivable from the purely astronomical observations are confirmed by many of a different character, and especially by the observed intensity of the radiation of the heavenly bodies. Thus, the first radiation thermometer exposed was broken in a few minutes by the power of the sun proving to be so much greater than had been anticipated by the maker in England. Two other thermometers were then brought out, that had been prepared according to M. Arago's idea, and the greater strength of the sun in France; but, though marking as high as 180 deg., they were soon proved to be insufficient to register the extraordinary intensity of the sun's rays there; for by 10 o'clock in the morning the mercury had not only reached the top of the scale (180°), but was filling the upper bulb to an unknown extent.

This excessive radiation abundantly proved that Guajara was precisely the place for the normal series of actinometer observations required by Sir John Herschel. For this purpose two actinometers at least were necessary; but up to the time of leaving England neither the Prof. nor his friends could hear of the existence of more than one. That one belonged to Mr. Airey, and he not only lent it to him, but ordered a second one to be made and sent out to Teneriffe as soon as possible. Unhappily, it only arrived as he was leaving the island, on the 26th of September, and then in a damaged condition, while the other one, when opened on the mountain, was found to have been injured in its most essential part —the internal thermometer—as well as to have leaked. Means, however, of getting over these difficulties were extemporized, and observations were begun in that region so promising for solar radiation; but on the second day the gradual shrinking of the wooden parts of the apparatus split the glass parts—"the end," says Prof. Smyth, "of too many of our instruments in that climate, where, besides the direct radiation, there reigned a continual dryness, with a severity unmitigated, beyond any precedent known to the opticians at home."

Happier was the inquiry into the radiation of the moon by means of the Admiralty delicate thermomultiplier, lent by M. Gassiot. The position of the moon was by no means favorable, being on the night of the full, 19° south of the equator; but the air was perfectly calm, and the rare atmosphere so favorable to radiation, that a very sensible amount of heat was found both on this and the following night. The absolute amount was small, being about one-third of that radiated by a candle at

a distance of 15 feet; but the perfect capacity of the instrument to measure smaller quantities still, and the confirmatory result of groups of several hundred observations, leave no doubt of the fact of their having been enabled to measure here a quantity which is so small as to be altogether inappreciable at lower altitudes.

(To be Continued.)

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*Photographs on Factitious Ivory.** By J. E. Mayall, London. *Patent, dated October* 24, 1855.

This invention, by the well known photographer of Regent Street, relates to the use of artificial ivory for receiving photographic pictures instead of glass or paper. This artificial material, which possesses all the properties and beautiful finish of ivory, and allows of any subsequent tinting of the image, and the obtainment of superior softness in the semi-tints, is what is known in France as Pinson's artificial ivory, consisting of a compound of gelatine and alumina. This material is prepared in the form of slabs, for the photographer's use, in this way:—The tablets or slabs are composed of gelatine or glue in its natural state, and are immersed in a bath of alumina, which is held in solution by sulphuric or acetic acid; by this means, a complete combination takes place between the alumina and the gelatine or glue. The tablets or slabs should remain in the bath a sufficient time to become thick enough for the purpose for which they are required, and to allow the alumina to entirely penetrate them and incorporate itself therewith; they are then removed and allowed to dry or harden, when they may be dressed and polished by any of the ordinary and well known processes for polishing ivory.

Artificial ivory tablets, capable of bearing a fine polish, may also be made by mixing alumina directly with gelatine or glue; but this process is not so satisfactory as the process hereinbefore described, since the thickening produced by the admixture of the alumina with the gelatine, renders the manufacture of the sheets both difficult and expensive.

Another composition of artificial ivory which is employed, consists of equal portions of bone or ivory dust, used either separately or combined, and albumen or gelatine, the whole being worked into a paste, and afterwards rolled out into sheets by suitable rolling or flattening mechanism. The sheets are then allowed to harden by exposure to the atmosphere, and are cut into slabs or tablets of the required size. But it is preferred to use two parts of fine powdered baryta, and one part of albumen, well worked together, and rolled out into slabs. The best plan hitherto discovered for working the materials together, is that commonly used in the manufacture of Parian marble; this composition may also be used spread upon paper, if desired. These slabs or tablets are then carefully scraped, to give them a perfectly even surface. They are then washed with alcohol, to remove any impurity therefrom, and are prepared in the ordinary manner to receive positive pictures. The pictures having been printed, the entire slab or tablet may be immersed for a few minutes in a weak solution of nitro-sulphuric acid or nitro-hydrochloric acid, for the purpose

* From the Lond. Prac. Mech. Journal, Jan., 1857.

of rendering the picture more clear and brilliant. It is then fixed in the usual manner with hypo-sulphite of soda, and is washed, and then dried on a marble or other slab, or under pressure, to prevent it from warping.

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*Improvements in Knitting Machinery.**

Besides the great inventions which startle the world at their first announcement by the magnitude of their expected results, there are others of more modest pretensions which should have interest for us from the stimulus they give to further improvement. In the present number we publish a selection from the more recent of the enrolled specifications, relating to the manufacture of knitted fabrics, for the purpose of showing the direction which invention is taking in that branch of industry. This example of progress is an apt illustration of the relation which a new idea struck out bears to succeeding improvements; and as such, it may be well to consider the case here presented to our view; for the advance made in knitting machinery, though slow, and silently effected, is still worth calling an advance—inasmuch as the speed of production has been greatly increased, though much yet remains to be done to bring the hosiery manufacture on a par with that of lace or woven goods. The most notable improvement in knitting machinery effected during the present century, is the introduction of the circular knitting frame: this was hinted at by the late ingenious mechanician and engineer, Sir Isambard Brunel, and a machine designed on this principle was even patented by him in the year 1816; but nothing came of this valuable suggestion, and it was forgotten, if ever known by the trade, only to be raked up and brought against the inventor of the first successful circular machine; who, being a foreigner (a Belgian we believe), patented his improvements in England in 1842, as a communication to Mr. Tielens. Quickly following upon this were a series of improvements introduced by M. Claussen, and patented by him in the years 1845 and 1847. The utility of this ingenious mode of applying rotary motion to the working parts of a knitting machine, was fully demonstrated some six years ago; and the French department of the Great Exhibition of 1851, gave further proof, if that were wanting, of the efficiency of that class of machinery. Among the group of seven specifications selected to illustrate the recent progress of the knitting manufactures, it will be seen that five relate to circular machines; thus marking the estimation in which the original idea of Brunel is now held by the trade. But there is another circumstance worthy of note as showing the value of a casual hint, and that is, the use which several of these patentees now propose to make of the well known double-headed and hinge-bearded needles. Their application is not even confined to our own manufacturers, for an inventor, from the other side of the Atlantic, proposes the introduction into a circular machine of the hinge-bearded needle, and that apparently under the idea that he is the originator of the needle as well as the means of using it. The credit of introducing the double-headed needle, which permits of the manufacture of ribbed fabrics with like faces on both

* From Newton's Lond. Journ., Nov. 1856.

sides, is due to Messrs. Townsend and Moulden, who, in 1849, patented this improvement, and with it the jointed or hinge-beard, which enables the formed loop to be pushed off the needle without the use of a presser-bar for depressing the needle beard and allowing the loop to slide over it. Trifling as these improvements may appear to one not engaged in the trade, we get to understand far better their value and the credit due to their originators, when we see them used by other inventors as the stepping-stones to further improvements. Whether the time is ever again to return when inventors will resume their proper place in the estimation of mankind, we know not; but appealing as we do to a public that can rightly appreciate the labors of others in quickening the pulse of industry, and through it of commercial enterprise—we care not to count with those who ignore the existence of the men to whom we are indebted for the ever increasing benefits presented to us, either in the form of cheaper or better, or hitherto unknown articles of manufacture, or of increased facilities of transit for ourselves, our goods, or our thoughts and wishes. This, therefore, must be our excuse, if any were needed, when we point attention to unpretending improvements which have neither been trumpeted to fame by injudicious friends, nor decried and denounced into public notice by as injudicious enemies.

Messrs. Townsend and Moulden's needles, which offer the advantages above stated, are designed by four out of seven of these patentees, to take the place of the ordinary needle. But while the existence of the old stocking-frame, as left to us by the Rev. William Lea, is threatened, we find another inventor stepping forward to rescue it from oblivion, and impart to it new vitality by the addition of the Jacquard apparatus. It would astonish the original inventor of this beautiful contrivance, whereby an apparent intelligence is imparted to inanimate matter, could he but see the uses to which his great discovery has been already applied. After performing wonders on the loom, it was, comparatively lately, introduced to the lace machine, and with the like results; and now, thanks to Mr. Turner, of Leicester, it is brought to act upon the needle beards of the common stocking-frame, and produce patterns in the fabric with the greatest ease. We look with interest on the success of this suggestion of Mr. Turner, for it is a move in the right direction, and shadows forth, as we believe, a new era in the manufacture of hosiery; for the Jacquard being once successfully applied, and varieties of patterns produced with facility, the demands of the public will become more exacting, and progress will necessarily result.

Dyeing.

M. Fr. Kuhlmann having remarked that when eggs were dyed, some of them took the colors better than others, and that this fixation of the color took place without any mordant, was led to suppose that, in these cases, the fixation was due not to the calcareous salt of which the egg-shell is formed, but to an azotized coating upon its surface. This supposition was verified by experiment. As the coating of the egg-shell is very analogous to albumen, this latter substance, coagulated by heat,

was tried separately in baths of Brazil wood, &c., and its absorbing power thus shown. M. Kuhlmann then tried the use of this substance, for the purpose of increasing the absorbing power of different tissues; he obtained very favorable results with cotton, less distinct with silk, scarcely perceptible with wool; these trials were made with Brazil wood, madder, and Campeachy wood. After albumen, he tried with the same success milk and caseum, which may be coagulated on the surface of the tissues by means of an acid. Milk, especially alone or in connexion with mordants, gave the cotton very full colors. He experimented also upon gelatine coagulated by tannin, and obtained results, although feeble, without mordants. He also showed that albumen may serve as a medium for precipitating upon stuffs, metallic oxides, with which it forms insoluble compounds; in dyeing, stuffs impregnated with these compounds, absorb colors with more ease than if they had been prepared either with albumen, or with the same metallic salts alone. Analogous results were obtained with tannin-gelatine.—*L'Institut, 26th November.*

Specifications of a patent granted to ALEXANDRE TOLHAUSEN, *for a new process of producing chemical writing, and of marking and inscribing chemically, any characters or figures upon paper or other substance of similar character; being a communication.*—Dated March 26, 1856.

This invention consists in a process for producing chemical marks or writing on paper, without using a liquid like common inks, by employing chemically prepared paper, and a chemically prepared pencil, style or other like instrument, to trace, write, or mark on the paper, whereby the salts or substances in the pencil and paper, when they come in contact, will chemically unite under hygroscopic conditions at the natural temperature of the atmosphere, and will form visible chemical colored marks or writing on the paper. Hygroscopic conditions are necessary to the process to effect chemical writing: moisture is the agent which enables the salts or substances used to effect chemical union, but no liquid is employed.

To prepare the paper, the common sizing that is used for writing paper is saturated with a salt or salts, or substances of considerable solubility, and which, when dried with the paper, will maintain its dryness and freedom from moisture under ordinary atmospheric changes. Colorless salts or substances are preferred for this purpose, or they may be of such a light tint as not to be different from the color of writing paper. This salt or salts, or substance, is to form the ground for the colored marks or writing to be produced on the paper. Various salts may be used for this purpose, according to the color of the marks or writing to be produced: For instance, to produce blue marks or writing, the paper is prepared with ferrocyanide of ammonium, which is very soluble in water, or with salicylic salts. To make black marks or writing, indigolic

* From Newton's Lond. Journ. of Arts and Sciences, Nov. 1856.

salts, euxanthic salts, and morphine salts are used. To make red marks, meconic salts, kemenic salts, pyromeconic salts, and angelic salts are used. To produce green writing or marks, the paper is prepared with caffeic or themic salts. These salts, either singly or a mixture of those specified for each color, are mixed with the sizing of the paper, which is applied in the usual manner, and the paper is afterwards dried and pressed in the common way. No certain quantity of these salts requires to be described, but about one ounce of any of them is sufficient to impregnate the sizing for about half a ream of common foolscap paper; a lesser quantity being used to produce feebler colors, and more to produce darker shades. Other well known salts than those specified may also be used, but those named will effect the results herein described—the principal feature of this invention being to produce chemical writing without an ink. The patentee now takes a deliquescent salt, and, for cheapness, he prefers a ferric oxide—the nitrate, chloride, or sulphate of iron, obtained in any of the usual methods. This salt is triturated and mixed intimately with plastic clay, in about the quantities of an ounce of salt to a like quantity, by weight, of clay or similar substance. The ferric clay is then moulded into any desired form to constitute a pencil or tracing instrument, and is afterwards baked in an oven, to drive off the moisture by heat. The heat is continued, at about 212° Fahr., to drive off all the moisture and to harden the clay. When this is accomplished, the ferric pencil or tracer is removed from the oven or other place, and plunged into molten bees-wax, spermaceti, or any substance of similar character, which will form an air-tight coating, and not decompose the ferric salt. The chemical pencil or tracer, thus produced, may be placed between strips of wood, like a common lead pencil, or it may be placed in a metal pencil-case, and the point of it scraped to expose it to the air. The chemically prepared paper, previously described, is now traced, pressed, or written upon with the pencil or instrument described. The ferric salt in the said pencil, during the act of writing, when exposed to the atmosphere, absorbs moisture; and when it (the ferric salt) comes in contact with the salt or substance in the prepared paper, the salts or substances in the pencil and paper unite chemically (forming double decomposition), producing a new ferric compound in the prepared paper, and thereby producing chemical colored characters, marks, or writing. Any of the ferric salts named for the pencil will produce the different colors mentioned on paper prepared with the substances heretofore specified for producing these colors. The pencil or tracer may also be made of a very porous substance, which may be steeped in a solution of ferric salt, then dried to expel the moisture, leaving the salts in fine crystals in its pores: it is then plunged into bees-wax, as described, for the above described pencil, and for the same purpose. Type may be formed in the same manner as the ferric clay pencil described, and chemical printing may be executed without the use of common topical ink, which in some cases may be advantageous. A very porous fountain pencil may also be made, one whose pores will permit fine ferric salt to percolate as it were through them, and be transmitted to the paper in the act of tracing or writing, and impressed on the paper by a hard point on the pencil, to bring the salt or salts in the

pencil and prepared paper into contact, when the two will unite under hygroscopic conditions of the ferric salt, and produce the chemical marks and writing heretofore described.

Another method of obtaining the hygroscopic condition necessary to form a chemical union between the salt or substance in chemically prepared paper and a pencil, without employing a deliquescent salt to produce chemical writing on paper, is to use glycerine as a component part of the chemical pencil or marker. Without the employment of a solution it will afford the same requisite amount of moisture as a deliquescent salt. Paper prepared with starch, as a sizing, will produce blue marks or writing, if it be traced upon with a porous pencil or fountain pencil containing iodine and glycerine—the latter not being present as a liquid, but simply as a hygroscopic agent.

Another method of producing the same chemical marks or writing on paper as those described is, to prepare the paper in the same manner as that first described, and employ a dry salt in the pencil, and supply the hygroscopic conditions necessary to form the chemical union of the chemically prepared paper and pencil during the act of writing or tracing, by placing a moist sheet of paper under the paper to be written upon; or they may be supplied, after tracing or writing, by pressing a sheet of moistened paper on the written or traced surface; by either of which acts the salts will receive the necessary supply of moisture to enable them to form double decomposition, and produce chemical marks or writing on the paper. The salt or salts preferred for making the dry salt chemical pencil, for producing chemical writing or marking, of the character described, are the tartrate of iron, the terpersulphate of iron, or any of the permanent iron salts.

Heretofore it has been a desideratum to obtain a superior substitute for the common lead or plumbago pencil and the crayon, and also for the method of writing with a fluid-like ink. The lead pencil and crayon only make mechanical marks, which are easily erased; and writing with ink is troublesome, because the pen has to be often replenished.

This improved method or process will produce chemical marks or writing equal to those made by inks; and the method of writing or producing them is as easy as the act of writing with a common pencil. It will be a superior method of writing on books and bills, and making permanent records on paper. It will afford security against alteration of the writing on records, as it will require the specific salts in the pencil and paper to produce a writing similar in color and shade to that which is attempted to be supplanted, changed, or altered, and to that on the part of the document written upon. This process obviates the evils and objections incident to the use of a common pencil or pen and ink.

The patentee claims "producing chemical marks, records, or writing, on chemically prepared paper, as described, by tracing, pressing, or writing with a chemically prepared pencil, style, tracer, type, or other suitable instrument, on such paper, under the hygroscopic conditions herein described, or in any manner substantially the same."

*Wright's Improvements in Manufacturing Boilers, Iron Ships, etc.**

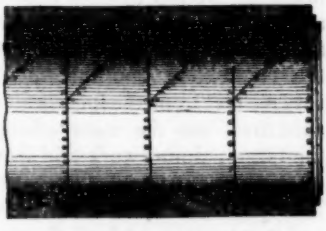
In the ordinary manufacture of cylindrical boilers, the plates are so arranged that the riveted joints run in lines parallel to the axis of the boiler, and in planes perpendicular to the axis; or, in other words, the joints run in the direction of the length of the boiler, and at right angles to it. The joints running parallel to the axis of the boiler, or the longitudinal joints, it is well known, are subjected to a greater strain than those crossing them at right angles and running round in planes perpendicular to the axis, and consequently the longitudinal jointing is the weakest, and the part of the boiler first to give way under great pressure.

In order to remove this defect, Mr. E. T. Wright, of Wolverhampton, has patented an invention which consists in so arranging the riveted joints of boilers, and other articles of similar manufacture, that they shall not run parallel to the axis, but in a line oblique thereto, the lines of plates being made to run round the axis of the boiler in a helical or corkscrew direction, and the joints either at right angles to one another, or varying from a right angle, so as to be oblique to the direction of the greatest strain. "By thus placing the lines of riveted jointing oblique to the direction of greatest strain," says Mr. Wright, "any given amount of such greatest or lateral strain is resisted by a greater length of jointing, and consequently greater number of rivets, than when such line of jointing is situated parallel to the axis of the boiler, whilst the whole length of jointing and number of rivets in the boiler is not increased, or is increased only to an inconsiderable extent."

Fig. 1 of the accompanying engravings represents in side elevation a cylindrical boiler of the improved construction, with hemispherical ends.

Fig. 1.

Fig. 2.



The oblique position of the joints and the arrangement of the plates in the form of helices are so clearly indicated that a further description is not necessary.

"The amount of increased strength of joint will appear," says Mr. Wright, "on referring to fig. 1. The dotted line, *a b*, will represent a given length of lateral strain, say 1 yard. This amount of lateral strain, instead of being resisted by only one yard, or an equivalent length of jointing, it will be perceived, is resisted by a length of jointing represented by the two lines, *a c* and *c b*, together equal to 1414 yards."

Fig. 2 represents, in side elevation, another cylindrical boiler. In this

* From the Lond. Mech. Mag., Nov., 1856.

the plates are disposed in the usual manner, but they are not rectangular, but of a lozenge shape, or have ends which, although parallel to one another, are not at right angles to their sides. Mr. Wright does not, however, consider the mode of construction shown in fig. 2 to be so desirable for boilers as that shown in fig. 1, because the length of jointing in the boiler is increased.

The application of the invention to iron ships, &c., consists of an oblique arrangement of the riveted joints, similar to that before described and illustrated.

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*Experiments on Iron Targets.**

Some experiments have been made at Woolwich, to test the power of resistance of timber lined with 4-inch iron plates—the combined materials being of the same thickness as the immense floating batteries constructed during the late war; and also to test the durability and quality of iron plates manufactured by rolling, as compared with iron turned out by the hammer. The target was an immense construction of timber, lined with 4-inch plates of iron of both descriptions, and the total weight was 30 tons. This target was placed on a foundation constructed for the purpose, and 24 rounds of 68-pounders were fired with the following results:—The first 14 rounds were fired at a distance of 600 yards, and after the first few rounds the timber work gave way in several directions. The last 10 rounds were fired at a distance of 400 yards, and the work of destruction commenced was now consummated. The timber work of the target was completely broken and splintered, and the plates of iron made by the rolling process were cut up and split, having apparently but little adhesion. The iron plates which had been made by the old process resisted the solid wrought iron shot much more successfully, and it was apparent that these plates possessed more adhesive power than the rolled plates. Such was the tremendous force of the cannonade that the immense target was forced by the concussion several feet from the foundation or box on which it was placed. The last shot fired was the most effective. This shot went completely through the target, timberwork and iron included. It was the subject of remark by several practical men that the principle of combining timber with iron plates, was, no doubt, the best that could be at present adopted; but it was evident from these experiments that such plates must be improved upon before they could resist the concussion of repeated discharges of heavy shot.

The Laws of the Strength of Wrought and Cast Iron.†

A paper on the above subject, was read at the Institution of Civil Engineers, on Tuesday, December 9, by Mr. William Bell.

In this paper, it was stated, that the chief point had been the consideration of the longitudinal, as compared with the transverse, strength

* From the Lond. Mining Journal, No. 1113.

† From the Lond. Mech. Mag., Dec., 1856.

of wrought and cast iron. For this purpose the whole of the experiments made up to the present time, on tearing asunder or crushing bars of cast iron, and those made by breaking bars transversely, had been taken, and from them, and the known formulæ of elasticity, such values of the constants in the formulæ had been deduced, as would satisfy each experiment individually. And by comparison a general view of the accordance or non-accordance of theory with experiment had been obtained, and some general laws arrived at.

The mathematical theory of elasticity, as given by Poisson and Navir, was assumed. By finding, for each experimental beam, the centre of gravity of the area of cross section, through which, according to this theory, the neutral axis passed, and calculating the moment of the forces with respect to this axis, the application of the formulæ to the experiments was easily made.

The first constant obtained, was the weight per square inch of the modulus of elasticity, and this, when deduced from the transverse strain, was taken from the deflexions produced by small weights, and in all cases where the beam or bar was very little strained. For wrought iron, the most comparable experiments were considered to be those detailed in the "Iron Commissioners' Report," which gave, by transverse strain, from 12,200 tons to 12,750 tons per square inch, and by extension of bars from 12,200 tons to 12,900 tons per square inch. For cast iron the averages of Low Moor, Blaenavon, and Gartsherrie irons were from tension 6305 tons, from compression 5698 tons, and from transverse strain 5968 tons per square inch. Other experiments on the transverse strain of wrought iron gave from 9000 to 14,000 tons per square inch; whilst with cast iron the results were found to vary from 4000 to 8000 tons. On this point, it was stated, that Mr. W. H. Barlow, F. R. S., M. Inst. C. E., in some experiments on the neutral axis, recently laid before the Royal Society, found results nearly agreeing with the higher number.

Another mode of arriving at the value of the modulus of elasticity, by means of the bending or breaking weight of "long pillars," was also examined; the ratios of the lengths of the pillars to their diameters being taken as abscissæ, and the bending weights, obtained both from theory and experiment, as ordinates. It was thus found that, for the experiment on wrought iron pillars given in the before-mentioned report, the curve of theory agreed very well with the curve of observation, until the length became shorter than seventy times the thickness. The experiments on cast iron pillars examined were those in the second volume of "Tredgold on Cast Iron." The correspondence with theory was very good for those with the ends rounded, until the length became shorter than twenty times the diameter; and for those with the ends flat, until the length became shorter than fifty times the diameter. The hollow cylindrical pillars, with one exception—that of a short pillar—gave values for the modulus of elasticity of from 4350 to 6680 tons. The correspondence between theory and experiment seemed, in the author's opinion, to warrant the conclusion that the theory was perfectly trustworthy when only small compressions and extensions were concerned.

The fundamental assumptions usually made in the theory of the strength of materials were then considered. First, that in a beam strained trans-

versely, the extensions and compressions of the particles were proportional to their distances from the neutral axis. Second, that the extensions and compressions were proportional to the tensile and compressive forces—known as Hooke's law, and by the phrase, *ut tensio, sic vis*. And third, supposing the latter law to hold good, that whenever in a beam subjected to transverse strain, the tension or compression on the outside particles was the same as would be obtained by direct experiment on pulling asunder or crushing bars of the same material, the beam gave way. It appeared, however, from experiment, that for large compressions and extensions, the law of Hooke ceased to be applicable. It was found that in cast iron, this law did not differ widely from the truth within the range of the experiments; whilst in wrought iron, although the difference was great near the point of rupture, yet the curve of compression was similar in form to the curve of extension, the ordinates likewise being nearly equal in amount. The true law might, therefore, be roughly expressed by saying that, beyond a given amount of force, the same force corresponded to all compressions and extensions, this force being nearly the force of rupture, either by longitudinal compression or extension: in other words, the force was scarcely altered by a large increase of the compression or extension. It was next considered what effect this deviation from the law of Hooke would have, as to the force on the outside particles, as deduced from that law; the supposition being made that the force was constant, and therefore equal to the force of rupture for all compressions or extensions. From this investigation, the author thought it would be obvious, that the supposition of a constant force was different from the truth in one direction, while the law of Hooke was different from it in another, so that these two laws formed limits between which the truth always lay; in cast iron the latter law being more nearly approximated to it. It was shown that the results derived from experiments, by assuming the ordinary law, were slightly above the truth, the difference, even in a rectangular section of wrought iron, being probably less than 20 per cent., and in cast iron still smaller, while in large box and double T girders with a broad bottom flanch, the difference was practically insensible.

The other constant obtained was the value in tons per square inch of the tension and compression of the outside particles, when the beam became ruptured by transverse strain. For wrought iron the experiments on solid iron bars were fewer than could be wished, and gave results varying between 14½ and 18½ tons per square inch. In this material it was thought that it might probably be the compressive, rather than the tensile force which determined the fracture. The only experiments on the direct compression of wrought iron were those on two bars, given in the Iron Commissioners' Report—where one gave way under a strain of 14·5 tons, the other under 13·8 tons per square inch. The quality of iron was not stated, but it was believed to have been soft. It was asserted that the better kinds of wrought iron were able to sustain a greater tensile force, the worse kinds a greater compressive force. According to Mr. Eaton Hodgkinson's experiments, wrought iron might be defined to have its tensile to its compressive force, nearly in a ratio of equality; cast iron to have those forces in a ratio of about one to six.

This being so, it was thought worthy of consideration, whether in the plates of a large wrought iron bridge subjected to compression, a slightly inferior quality of iron might be used, not only as more economical, but as better in itself.

With regard to riveted iron, the results from all the wrought iron tubes in the before-mentioned report, gave from 7·1 to 24·8 tons per square inch. The lower numbers were apparently caused by using thin plates for tubes of comparatively large diameter. If this were avoided, it was thought that in calculating the strength of wrought iron tubes, 15 tons per square inch might be allowed for the breaking force on the outside particles.

When the experiments on cast iron were examined in this manner, the following fact became apparent; experiments on small bars broken transversely gave results of 20 tons, and even more, for the tension and compression of the outside particles, when the experiments were examined by the ordinary theory. If these results were diminished by 20 per cent., which it appeared would more than make up the difference caused by assuming the ordinary law, there was still a result of, say 16 tons, while by direct experiments on the tensile force of cast iron, 7 or 8 tons were found to be the utmost that it would bear. In regard to this subject, Mr. W. H. Barlow had adduced the alternative hypothesis that the neutral axis shifted its position as the beam became strained, and that when rupture took place the neutral axis was "at or above the top of the beam." This hypothesis was considered by the author to be contrary to the elementary principles of mechanics; for as the sum of the compressive forces on one side of the axis must be equal to the sum of the tensile forces on the other, therefore if there were tensions on one side of the axis, there must be an area out of which to get compressions sufficient to balance them on the other. As evidence on this point, in one material, the observations of Sir David Brewster in passing polarized light through a piece of glass subjected to transverse strain were alluded to.

In experiments on the direct tensile strength, it was assumed that the outward force was uniformly distributed over the area of the bar; in other words, that the resultant of the external forces acting on the bar, passed through, and had the same direction with the axis. This probably obtained in wrought iron from its great extensibility before rupture; but in cast iron there was no such extensibility, and this point was, therefore, to some extent, doubtful. If a few experiments were made, in which the force deviated from the axis by certain large and measurable amounts, and then were made to approach the axis, until some law was obtained which could be tested, this point would be set at rest. A table was then given, showing the values of the forces on the outside particles at the time of rupture, in tons per square inch, from which it appeared that there was a diminution as the size of the beams increased. Beams 3 inches by 3 inches, as compared with those of 1 inch by 1 inch, showed a falling off of strength to the extent of about 4 tons per square inch. The results derived from Mr. Hodgkinson's and Mr. T. Cubitt's experiments gave about 10 tons per square inch, when the sound beams only of the latter experimenter were included in the calculation, or 9·6 tons

per square inch when the unsound beams were taken into account. From this table it appeared, that the breaking weight of tolerably large girders might be calculated with considerable accuracy, by using 7 or 8 tons per square inch as the force of tension on the outside particles, when rupture took place.

In conclusion, the author expressed the hope that he had succeeded in establishing the following propositions:

First. That in experiments where the materials were but slightly strained, theory and experiment coincided.

Second. That where the ordinary theory was applied to the rupture of beams, and especially large beams, of wrought iron, theory and experiment practically coincided.

Third. That there appeared to be no good reason for supposing that the neutral axis shifted its position to any extent worth noticing, even up to the time of fracture.

Fourth. That in cast iron, although theory seemed to differ from experiment, when the transverse strength of small bars was compared with the direct tensile strength, assuming the latter to be correctly stated at 7 or 8 tons per sq. inch, yet when the transverse strength of large girders was compared with the direct tensile strength, the coincidence of theory and experiment was nearly exact.

Fifth. That the ordinary theory of the strength of materials was more trustworthy than was generally supposed.

In an appendix, the author explained the formulæ used in examining the experiments, and gave the demonstrations of the results arrived at; the experiments for ascertaining the modulus of elasticity, and the forces on the outside particles at the time of rupture, being examined in great detail.

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*Substitute for Iron Pipes and Brick Sewers.**

The heavy cost of iron mains or pipes, and the great expense of laying them in trenches under roads, together with their short duration (from oxidation), liability to flaws, fractures, defects in joints, &c., are disadvantages universally felt; and the interruption of traffic, consequent upon the almost constant repairs going on in the streets, is so serious an evil, that it is absolutely necessary some remedy should be devised, particularly in the metropolis. It is also now considered imperative that the public generally should be provided with a more copious supply, and better quality of water, than heretofore, and that the sewage should be quickly collected and as quickly removed. For the attainment of these objects, substantial and imperishable conduits or tunnels are essentially necessary. The iron pipes and brick sewers now in use, are not adapted to the purposes—the first being costly, rapid in decay, and rendering the water impure; the last, although less costly, absorbing the sewage, and retaining much of the foul matters intended to be removed and discharged, and eventually becoming a mass of corruption. To provide a substitute, which shall be equal if not superior to the famed Roman conduits and aqueducts, has occupied the attention of Mr. William Austin,

* From the Lond. Civ. Eng. and Arch. Journ., Dec., 1856.

for many years past, and he has at length produced and patented an imperishable and economical material in blocks of peculiar form, for the rapid construction of conduits, aqueducts, sewers, tunnels, well-pits, mine-shafts, towers, light-houses, and similar cylindrical constructions. The blocks are also available for walls of buildings in general; also for wharves, sea or river walls, docks and harbors; in which latter case a straight-faced block is provided, dovetailing in its bed and end joints (perforated if required), and forming a compact, immovable, indestructible, rocky mass, proof against the action of salts, acids, frost, or fire.

Fig. 1.

Fig. 2.

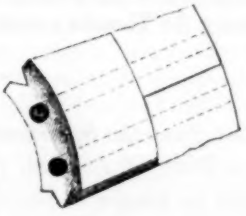


Fig. 3.

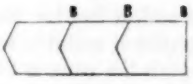
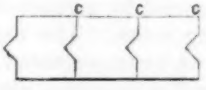


Fig. 4.



In the accompanying diagrams, fig. 1, when viewed vertically, shows a plan of a tower or shaft, and viewed horizontally is a section of a tunnel, aqueduct, or conduit, formed of these blocks, showing at A, A, A, the bonding of alternate joints, as indicated by the dotted lines. The orifices come opposite to each other in succession, as seen in fig. 2, which is a perspective view of the circular block; and through the orifices, bolts, chains, dowels, or grout can be passed or run to act as ties. The blocks also dovetail in their ends or beds, as seen at B and C, figs. 3 and 4, securing additional strength and stability, and becoming a locked and immovable structure, of a character somewhat similar to the vertebræ of animals.

These blocks can be cut in a soft working stone, and then by induration be rendered intensely hard and impervious to moisture or frost; or the blocks can be formed in iron moulds from indurated pulp, made from sand, chalk, pebbles, gravel, brick-dust, road scrapings, and which, not requiring to be burnt in a kiln, are consequently not liable to torsion or twisting, but remain perfect fac-similes of the various iron moulds or shapes.

The application of these blocks has been suggested by Mr. Austin, in connexion with his project (which has been laid before the Metropolitan Board and the public), for removing the whole of the metropolitan and suburban sewage by conduit tunnels under each shore of the Thames.

All the sewage now discharges into the river: it would then, as proposed by him, be carried below each mud-bank without any interruption; and if the under-shore tunnels be extended from Fulham to the mouth of the Thames, every particle of the valuable sewage, when properly deodorised in its onward progress, would be eagerly sought for and applied to the poor and waste lands of Kent and Essex on each side of the river. Mr. Austin suggests boundary or limit-width walls for the Thames water, having the conduit tunnels as footings for such walls, to prevent overflowing on each shore, and to redeem the waste marshes, converting them into corn and crop lands. Two important advantages would thus be combined—"the removal and useful application of sewage," and "the rendering the Thames a most handsome commercial river."

Extract from the Specification of a Patent granted to ISAAC ABRAHAM BOSS, *of London, for Improvements in Preparing Cane in order to render it Suitable to be Used as a Substitute for Whalebone.**—Dated April 29, 1856.—(A communication.)

This invention has for its object, improvements in preparing cane in order to render it suitable to be used as a substitute for whalebone. For which purpose the cane is first cut by being passed between two circular saws, the cane being moved past the saws by two grooved rollers, and it is supported by a grooved bed or guide, on to which it is pressed by a pressing roller. The canes having been properly cut on four sides, they are to be impregnated with a preparation of animal matter, which is obtained as follows:—Bones are steeped in a solution of chloride of lime, the bones having afterwards been dried, are softened by digesting with steam, they are then combined with a solution of alum, and the filtered liquor obtained is employed for impregnating the canes, by placing them in a suitable closed vessel with such fluid, and subjecting the same to a pressure of about twelve atmospheres. After the impregnated canes have been dried in currents of air, they are soaked in a solution of alum, and again dried and finished for use.

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*On the most convenient System of Measures and Weights, based on the Natural Pace of Man.** By C. A. HENSCHEL, of Cassel, Germany.†

Since the nations of the civilized world, urged on by a new state of things, are progressing and mutually competing in arts and sciences, in commerce and industry, and all are beginning to enter into intercourse with each other, it is no longer sufficient that each of these states should have its own peculiar yard or pound, which it may have decreed according to its own convenience. In future, nothing less than a general agree-

* From the Repertory of Patent Inventions.

† From the Lond. Civ. Eng. and Arch's. Jour., June, 1856.

‡ Translated from the German: being an abstract from a pamphlet, in which the said system is projected according to, and in connexion with, the metric system.

ment on one and the same system of weights and measures is likely to meet the wishes of all concerned.

That an agreement of this kind is becoming indispensable in modern times, has been pretty generally conceded, though as yet it has never been taken into serious consideration, owing partly to the obstacles in the way of introducing it being considered insurmountable, partly to a misconception of a measure which nature herself has indicated in the construction of our own body—namely, the pace of man, which is not only necessary to accomplish locomotion, but is also clearly indicated as being the most proper for taking measures. People began to think that the length of the human foot, instead of the pace, would prove the most desirable measure, and accordingly the same was fixed, but differently in each place, without having regard to uniformity; so that a multiplicity of measures was gradually brought into existence, from which state of things we have suffered since the building of the tower of Babel to the present day. None of the measures thus introduced and adopted for the transactions of daily life, such as the yard, cord, &c., are capable of affording that convenience and simplicity which the natural pace possesses, not excepting even the metric system, constructed with all the advantages which science has been able to offer.

In spite of all that has been done to systematize and fix the metre, and the admirable exactitude in pointing out and determining some foot-measures, such as the Prussian foot, determined by Bessel in the year 1816, the soldier, in all parts of the globe, constantly exercises and manœuvres by paces. He hurriedly takes his measure of the ground by paces, and by the same process he, as well as the sportsman, takes his shooting distance. In the same way, geometers take sketches for complicated details; and by exactly the same process, the traveler measures and marks the length of remarkable edifices, places, vessels, &c. Nay, even in common conversation we are more easily understood if moderate distances are described in paces; and all for the obvious reason that, by means of our daily practice of pacing, the length of the pace is always the most clearly before our mind. But, at the same time, people have unfortunately been guilty of inconsistency in adopting an artificial unit of measurement for other dimensions of one and the same object, particularly the height of houses, towers, masts, trees, mountains, and hills; thus the relation between length and height, which is far more important than the absolute size of these dimensions, has been disturbed to such a degree, that the intended clear perceptibility of things cannot be accomplished unless by a tedious reduction of figures. The simultaneous use of two measuring units (not to mention the legion of others) is, therefore, it must be conceded, a great evil, calculated to render most difficult all insight and judgment, whenever such must be taken instanter; and our wishes for a uniform system are silenced by our having become accustomed to believe that it cannot be otherwise. Fortunately, however, the evil alluded to is not a necessary one, for, having created it ourselves, under a false view of things, it will be admitted that we are at liberty to do away with it, after having gained a juster conception of the subject. And we can abolish the evil by adopting a measure of exclusive validity,

than which nothing is better adapted to meet the exigency—namely, the pace, owing to its peculiar convenience for the use of man.

The process of measuring will thus be brought to its third and last stage, that of convenience and simplicity; and the only problem yet to be solved will be to qualify the pace of man for an exact measure by properly determining it, as the same has been used since the earliest ages of man for an approximative measure; and finally to construct on that basis a system of weights and measures analogous to the metrical system, which would be most capable and sure of being easily introduced, owing to the metrical system now being pretty generally known.

In order to ascertain the average length of the human pace, the author has counted the paces of many persons, made on a piece of ground which had been previously measured and was clearly perceptible from his room; and as those whose paces he studied were not aware of being observed, their pace was as natural as could be desired. The average of 100 observations gave the result, that the length of the pace is equal to 800 millimetres, with few very slight differences. Further observations were made by some officers, who took an interest in the matter, and noted down the movements of troops on the road. If the regiments of the guards are excluded, owing to the unusual size of the men, the result of the military observations coincides precisely with the measurement of the average pace of civilians, viz: =800. This average length of pace, so well determined in figures by 0·8 metres, as well as the almost exact harmony of the result of both trials, cannot be considered as being the consequence of a natural relation between metre and pace, but only as a favorable coincidence, which, in this instance, is very welcome, because the introduction of a normal pace-measurement will be greatly facilitated by the aid of the metre. At the same time, all those who consider the metre essential as a constant natural measure, and are wont to regard the number of 40 millions of metres as being the circumference of the globe, will be satisfied when they see that such number can be just as well expressed by 50 millions of paces.

As regards the subdivision of the normal pace, the metre and other decimal measures having preceded, it must be admitted, without hesitation, that it will be best to regulate the pace, according to the decimal system, excepting, perhaps, those measurements, which in the daily transactions of the retail trade, at market, in shops, &c., can be most conveniently arranged by continuously halving measures and weights. In the first place, therefore, the pace is to be divided into ten equal parts, which tenths (being about the breadth of the human foot) we may name "new feet." If a tenth of such "new foot" is named "new inch," a tenth part of a "new inch" being called "new line," a system would be formed, perfectly analogous to the metrical division; to which must be added the convenience, that one would be free to choose one or the other of these measures, according to the size of the object to be measured, a convenience proved by experience. Of the multiples of the pace it would only be necessary to take the rod of the land surveyor at 5 paces, his measuring-chain at 25 paces, and, in general, the "new mile" at 1000 paces (making 125 to the centesimal degree). People will soon get accustomed to the shortness of this "new mile." Up to 1000 paces

no subdivisions need be taken, nor from thence up to the greatest length, viz: the circumference of the earth = 50,000 miles. Even in France people are gradually adopting the sole use of the "kilometre," being analogous to the "new mile." With regard to the other mode of subdividing the normal pace by continuous halves, it is only the yard as a measurement of length that deserves our attention. We take the yard to be equal to one pace, dividing the same as stated above into $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, &c., dividing the other side of the measure into 100 equal parts, in order thus to pave the way to the decimal division.

The superficial measures can be very simply adapted to the new system. The general unit, viz: the square pace, with its subdivision into 100 square feet, &c., seems to meet the exigencies of arts, industry, and science; and one acre of 1000 "new square paces," would be sufficient for land surveying. Hence, a "new square mile" would contain the following, viz: $1000 \times 1000 =$ one million of square paces, or 1000 new acres, which would be the most convenient figures.

Cubic Measures.—The general unit might be the cubic pace, which would be convenient for all measurements of larger volume, and for making calculations in practical life. Its subdivision into 1000 new cubic feet, and further decimal parts, would be sufficient for the purposes of science, building, mining, the mechanical arts, commerce, and industry; and only the retail trade, in order to facilitate the application in shops and at markets, would require another division of the cubic pace, in accordance with the principle of continuous halves, because the term "half" is the most easily understood. In this instance, the different measures of capacity for measuring grain and fluids, have principally to be taken into consideration, not only in regard to the correctness of the contents, but also with reference to the convenience of their size and form for daily use.

Weights.—Here we adopt, without further hesitation, the kilogramme, according to the same principle, as laid down above, in ascertaining the measurement of lengths; we take the kilogramme as being equal to 1000 "grammes," as it is used now, and find, that $(1 \text{ m.})^3$ $(0{\cdot}8 \text{ m.})^3$ the weight of a "new cubic foot" of water, equals 1000 "grammes" $\times$ $(0{\cdot}8 \text{ m.})^3 = 512$ grammes, which we may very properly call "new pound" ("livre"); the more so, as it agrees with the old pound usual everywhere, as nearly as can be desired, in the absence of a natural relation between metre and pace.

As regards naming the subdivisions of measures and weights, it would certainly facilitate their use, if these also could be uniform among all nations, but the difficulty which the introduction of the metrical system has met with in France, compared with the much easier introduction of this system in Holland, would seem sufficiently to prove that it would be well to take the special nomenclature as much as possible from the languages themselves. In the outset, it is of paramount importance to keep intact this system, based on the innate force of simplicity and convenience, whilst the linguistical part of it may properly be left to future development, till a period when the general union of languages will have made its progress—by railroad.

It is, however, absolutely necessary, that all old and contradictory customs in reference to sizes, division of measures and weights, be entirely done away with, as otherwise neither a general agreement on these things, nor the immeasurable advantages accruing therefrom, can be thought of. Accordingly, in France, as early as 1789, a desire for equal measures and weights began to show itself, and in 1790 it was determined that the Royal Society of London, and the Paris Academy of Sciences, joined with learned men of all civilized countries, should be induced to prepare a new system of measures and weights. But the events of that time were not favorable to the execution of a plan of such magnitude. It was thought sufficient to entrust it to a committee of the most celebrated French mathematicians and physicians, but unfortunately without considering the necessity of likewise joining to such a committee proper commercial and industrial capacities, to represent the special interest of these branches, which so immediately form the cornerstone of the material well-being of nations. The measuring of degrees, interesting as it is in a scientific point of view, with which the work was commenced, would then probably not have taken place, or at least a use would have been made of it, which had the convenience of the common measuring more in view, and the metre would not have received its present unpractical length. This defect in the metre can only be done away with, by changing it into a shorter measuring unit.

In Germany, where the evil of complicated measures and weights has been greatest from times immemorial, several governments have made attempts to unravel and unite the systems, but thus far without any complete success, because, despairing in the outset of the possibility of a thorough reform being consistently carried out, people were disposed to rest satisfied with partial successes. But this will not do with measures and weights. Everything that is done in this matter must bear a character of perfection as far as it is possible, because every change that became necessary hereafter, would require new ones, and thus again tend to complicate the whole.

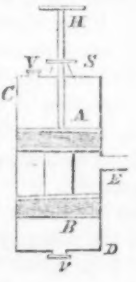
Whilst the same objections are applicable to all artificial measures, as has been proved above, and none can be recommended for general use, the exclusive application of the measure of paces, will serve infinitely to facilitate all kinds of measuring. All civilized nations concur in the opinion, that the time has arrived, when something decisive must be accomplished, and it is only to be apprehended that the impatient nations, who naturally wish soon to partake of the thing desired, might again resort to partial improvements, and thus again further remove the object of their wishes. Finally, however, though perhaps only after repeated failures, it will have to be admitted that a step backwards, to the sole use of the natural and inevitable measure which the pace suggests, will be the only means to relieve us from the obscurity of complicated measures, with their laborious reductions, mistakes, and loss of time; whilst on the other hand, it need not be apprehended that the measure of the pace, reinstated in its old rights, will ever again be superseded by a more convenient measure.

*On a New Double-acting Air-pump with a Single Clyinder.**

By T. Tate, F.R.A.S.

The chief points of novelty in this air-pump, consist in a double piston acting in a single cylinder, and in the superior system of valves. This double piston, with a single cylinder, gives to the instrument all the properties of an ordinary air-pump, with two cylinders: this new instrument, in fact, may be regarded as a single-barrelled pump, capable of performing its work with only one-half the usual motion.

The annexed diagram represents a section of the cylinder, &c., of my new air-pump: CD the cylinder; A and B solid pistons, rigidly connected by a rod, and moved by the piston-rod AH, passing through a stuffing-box s; v and *v* valves lifting outwards; R an open pipe at the middle of the cylinder leading to the receiver, from which the air is to be exhausted. The distance between the extreme faces of the pistons is about $\frac{3}{8}$ths of an inch less than one-half the length of the cylinder, this $\frac{3}{8}$ths of an inch being the space requisite for clearing the exhausting pipe R. The pistons are each about $1\frac{1}{2}$ inch in thickness, and the rod connecting them may be of any section consistent with strength. The effective length of the stroke is equal to the space between one side of the pipe R, and the corresponding end face of the cylinder, or it is very nearly equal to one-half the length of the cylinder.



In an upward stroke, the air above the piston A, is propelled through the valve v into the atmosphere, while a vacuum is being formed beneath the piston B. When the piston A strikes against the top of the cylinder, the air from the receiver rushes through the pipe R, and diffuses itself through the lower half of the cylinder. In a downward stroke the air beneath the piston R, is propelled through the valve *v* into the atmosphere, while a vacuum is being formed above the piston A, and so on. It will be observed, that *the double piston performs a double duty at every single stroke;* for while a vacuum is being formed on one side of the cylinder by one piston, the other piston is propelling air from the opposite side of the cylinder into the atmosphere.

This pump not only exhausts the air more rapidly than the common pump, but it also carries that exhaustion to a much higher limit.

This has been fully confirmed by actual experiment. I have had a pump made on this new principle, with a stroke of 8 inches, and $1\frac{1}{2}$ inch in the section,† and I have compared it with a superior pump on the old construction: the following is an exact statement of the results of my experiments.

Results of experiments with the new Pump.

Capacity of the receiver 108 cubic inches. Common siphon gauge.

* From the Lond., Edin., and Dub. Philos. Mag., April, 1856.

†This instrument may be seen at Messrs. Murray & Heath's, Philosophical Instrument Makers, Piccadilly.

Elasticity of the air in the receiver at the end of sixty *single strokes* = ·12 inches of mercury. Limit of exhaustion = ·05 inches of mercury.

Results of experiments with a common double-barrelled Pump, EACH PISTON *having a stroke of* 4 *inches.*

Capacity of the receiver, &c., as before.

Elasticity of the air in the receiver at the end of 120 strokes of the two pistons = ·6 inches of mercury.

Limit of exhaustion = ·3 inches of mercury.

The advantages of this new pump, as compared with the common pump of the same capacity of cylinder, are as follows:—

1. To effect the same exhaustion, the driving pressure moves over one-half the space.

2. From the superior construction of valves, the exhaustion is carried to a much greater extent.

3. From having a double stroke in a single cylinder, the expense of construction is considerably reduced.

4. As the exhaustion proceeds, the pressure requisite for moving the pistons becomes less and less. The contrary takes place in the common pump.

In the pump which I have constructed the valves are made of oil-silk, and the piston-rod is moved by the direct application of the pressure; but I purpose to construct a pump on the new principle, with metal valves covered with oil-cisterns, and lifted up by the stroke of the piston, and also with a pump-lever (or crank), attached to the head of the piston-rod. The pump thus constructed will most certainly exhaust the air from the receiver, until its elasticity is reduced to that of the vapor of the oil.

Hounslow, March 20, 1856.

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*On Photo-galvanography; or, Engraving by Light and Electricity.**

HERR PAUL PRETSCH, late manager of the Imperial Printing-office, Vienna, has invented, and is now perfecting, a very remarkable method of engraving, by the combined processes of photography and electricity. The following description of his invention is from a lecture delivered by him, on the 23d ult., at the Society of Arts:

My invention consists in adapting the photographic process to the purpose of obtaining a raised or sunk design, on a glass or other suitable plate covered with glutinous substances, mixed with photographic materials, which design can then be copied by the electrotype process, so as to procure plates suitable for printing purposes. The operator first coats a glass plate with a gelatinous or glutinous solution, suitably prepared with chemical ingredients, sensitive to light, as follows:—One part of clear glue is soaked in about 10 parts of distilled water, but the quantity of water depends upon the strength of the glue, and the state of the atmosphere. Meanwhile, there are prepared three different solutions, viz: a very strong solution of bichromate of potash, a solution of nitrate

* From the Lond. Mech. Mag., May, 1856.

of silver, and a weak solution of iodide of potassium. The glue is dissolved by heat, and a small quantity of it is added to each of the two solutions of silver and iodide. The remaining greater portion of the glue is kept warm, the solution of bichromate of potash added, and well mixed. After which the small portion of the glue with silver is added, and also mixed well, and allowed about ten minutes time for combining. Finally, the small portion of the glue with the iodide is added, the whole mixture strained, and it is then ready to be poured on the plates of glass or other suitable material. When dry, the coated plate is ready for exposure. The photographic picture, the drawing, print, or other subject to be copied, being laid on the prepared coated surface, they are to be placed together in a photographic copying frame, and exposed to the influence of the light. After a sufficient exposure, which is exceedingly variable, according to the intensity of the light, the plate is taken out from the copying frame, when it will be found to exhibit a faint picture on the smooth surface of the sensitive coating. It is then washed with water, or a solution of borax, or carbonate of soda, as may be necessary. The whole image comes out in relief with all its details, and, when properly done, with all its brilliancy.

If the original is a protograph, chalk, sepia, or Indian ink drawing, the copy represents the different tints in grains; if in lines, the copy will reproduce the lines.

When sufficiently developed, it must be washed with spirits of wine. The surplus moisture is removed, and the plate is covered with a mixture of copal varnish, diluted with spirits of turpentine. After some time, the superfluous varnish must be removed by oil of turpentine, and the plate treated again, or immersed in a very weak solution of tannin or other astringent liquid. During this part of the process, the plate must be carefully watched, and removed as soon as the picture or design is considered sufficiently raised; it is then washed in water and dried. In this state the plate is ready to be copied. This may be effected by the customary methods of rendering the coating conducting, and placing it in the electrotype apparatus, producing an intaglio copper-plate; or, if first moulded the intaglio mould furnishes the means of obtaining a relievo plate by electro-deposition in a similar way. To produce a *sunk* design on the prepared plates, I proceed as before, but after washing with the spirits of wine, the plate must be dried on a warm place, and in due time the picture or design will appear sunk like an engraved plate. The printing plates are produced as before described.

If an intaglio plate is made, it may be printed from, at the common copper-plate printing press; on the other hand, the relievo plate may either serve as the matrix for producing an intaglio printing plate, or it may be itself employed in "surface" printing, like a wood-cut. In the latter case, the narrow lines of the impression being sufficiently raised, the broad white spaces must be cut out on the printing plate, or built up in the matrix. The common well-known stereotype process, also affords another means of producing the necessary plate.

It is well known to practical men that any impression made by fatty ink can be transferred on stone or zinc, for the purpose of printing from it in a chemical way. This method can be also used in the present pro-

cess, and there are some hopes of obtaining a good impression from the first class plate, which can be transferred and printed.

After the delivery of the lecture, Mr. Roger Fenton, the recent Hon. Secretary of the Photographic Society, spoke very highly of the merits of the invention, and the progress made in the development of it during his absence in the Crimea.

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*Modification of Dry Collodion Process.**

If you deem the following modification of two dry collodion processes interesting to your readers, perhaps you will give it space in your next copy. It possesses advantages combined of the gelatine and glycerine, giving great density and definition, as will be seen by the inclosed small specimen. I prepare the plates with Ramsden's collodion in the usual manner, in a slightly acid bath; after well washing, a solution (made by dissolving 180 grains of pure gelatine in 20 oz. of water, filtering while hot, and when nearly cold adding 3 oz. of glycerine of a specific gravity 1·300,) is poured upon the plate for a few seconds, drained, and dried by the application of a gentle heat, or allowed to do so spontaneously. I have kept plates 38 days thus preserved without discovering any dimunition of sensitiveness. The print inclosed is from a plate kept 20 days with 35 seconds exposure—the lens a double-quarter plate, with ½-inch stop. I immerse the plate in cold water for 5 or 10 minutes before developing, which can be done with either gallic acid and nitrate of silver, or pyro-gallic acid. Samples of gelatine differ considerably, and in some cases I advise the reduction of the quantity. This can only be determined by experiment. I am, &c.,

E. Beckingham.

100, Bath Row, Birmingham, Dec. 3, 1856.

Razors from Uchatius Steel.†

The Austrian correspondent of the *Times* writes, with reference to the steel produced by Capt. Uchatius's new process:—"A committee, appointed by the French Ministry of Commerce (as fully referred to in the *Mining Journal* of Oct. 18,) has just reported that M. Uchatius, an Austrian captain of the artillery, has at length succeeded in making good cast-steel at a low price. The assurance has been given me that the steel, which can be made harder or softer, and more or less elastic, costs from 50 to 75 per cent. less than any other steel of the same quality, and personal experience enables me to state that Uchatius steel makes excellent razors."

Aluminum‡

Is coming into more general use in France. The eagles which surmount the colors of the army, hitherto made of copper, gilt by galvan-

* From the Lond. Athenæum, Dec., 1856.

† From the London Mining Journal, No. 1109.

‡ From the London Mining Journal, No. 1107.

ism, are now made in this new metal, and thus lighten the weight of the flag by nearly 2¾ lbs. Aluminum is more sonorous than bronze, and is, consequently, brought into use for musical instruments. Spoons and forks, drinking cups, &c., have also been formed of it. The weight of aluminum is only about one-fourth that of silver. Fine silver being worth 225 fr. the kilogramme, and aluminum 300 fr., a piece of the latter, equal in size to a kilogramme of silver, will be only worth 75 fr., instead of 225 fr.; thus a fork and spoon, which in silver would cost 50 fr., would be only 16 fr. in this new metal.

Webster's Elastic Metallic Tubes.

Mr. James. Webster, of Birmingham, has patented a method of making elastic tubes suitable for effecting the junctions of pipes exposed to variable temperatures, or of pipes which are otherwise strained or required to bend, as the tube-couplings connecting locomotives with their tenders, hose for fire-engines, &c. The improved tubes are composed of brass, copper, or other metal or alloy, and in them a series of corrugations are made in planes perpendicular to the axis of the tube, to give elasticity to the tube, and permit of its flexure within certain limits. He prefers to make the corrugations as deep as is compatible with the nature of the metal or alloy of which the tube is made, and so narrow that the shoulders between the corrugations shall touch each other on slight flexure of the tube.—*Lond. Mech. Mag., Nov.* 1856.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, February 19th, 1857.

John C. Cresson, President, in the chair.

John Agnew, Vice President.

Isaac B. Garrigues, Recording Secretary.

Letters were read from the Metropolitan Mechanics' Institute, Washington City, D. C., and referred to the Committee on Exhibitions.

Donations to the Library were received from the Royal Institution of Great Britain; The Institute of Actuaries, London; The Virginia and Tennessee Railroad Co., Lynchburgh, Va.; and from J. Ross Snowden, Esq., Fairman Rogers, Esq., and Drs. Wolcott Gibbs, Frederick A. Genth, and Thomas S. Kirkbride, Philadelphia.

Donations to the Cabinets from Judge S. Ross, Coudersport, Penna.; David Munson, Esq., Indianapolis, Indiana, and Edward Miller, Esq., St. Louis, Missouri.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer's statement of the receipts and payments for the month of January was read.

The Board of Managers and Standing Committees reported their minutes.

The Board of Managers reported that they had completed their organization by appointing the following Standing Committees for the ensuing year:—

On Publications.	*On Instruction.*	*Managers Sinking Fund and Finance.*
John C. Cresson,	John F. Frazer,	Samuel V. Merrick,
B. H. Bartol,	Frederick Fraley,	Frederick Fraley,
J. V. Merrick,	Isaac B. Garrigues,	John F. Frazer,
Fairman Rogers,	Alan Wood,	David S. Brown,
Washington Jones.	George Erety,	Joseph Harrison,
	Lawrence Johnson.	Evans Rogers.

The Committee on the Library reported that during the past year there had been added to the Library—263 volumes by Purchase.

239 " " Donations.

130 " " Exchanges.

632

Making the total number in the Library January 1st, 1857, to be 6962 volumes—exclusive of newspapers, pamphlets, &c.

Candidates for membership in the Institute (4) were proposed, and the candidates proposed at the last meeting (8) were duly elected.

The Standing Committees for the ensuing year were appointed by the President, and approved as follows:—

On the Library.	*On Cabinet of Minerals and Geological Specimens.*	*On Cabinet of Arts and Manufactures.*
John Allen,		
James H. Cresson,	Isaac H. Conrad,	James C. Booth,
George Erety,	John F. Frazer,	Thomas Bickerton,
Samuel B. Finch,	F. A. Genth,	Samuel Broadbent,
Raper Hoskins,	B. B. Gumpert,	William Erety,
James Lukens,	John L. Le Conte,	John M. Gries,
Henry K. Plumly,	J. P. Lesley,	David M. Hogan,
James D. Rice,	B. Howard Rand,	John T. Hammitt,
Thomas S. Stewart,	J. H. Slack,	F. de B. Richards,
Samuel S. White.	Lawrence Turnbull,	John Wallace,
	John C. Trautwine.	Joseph H. Warrington.

On Cabinet of Models.	*On Exhibitions.*	*On Meetings.*
William H. Clarke,	John E. Addicks,	William B. Atkinson,
James Dougherty,	John Agnew,	James Eccles,
George C. Howard,	George W. Conarroe,	William H. Gobrecht,
Henry Howson,	James H. Cresson,	Henry Howson,
Wm. H. Harrison,	Owen Evans,	Washington Jones,
Alfred C. Jones,	Joseph Harrison,	Alfred L. Kennedy,
Samuel W. Leinau,	Samuel V. Merrick,	Thomas S. Martin,
Percival Roberts,	Thomas S. Stewart,	B. Howard Rand,
Charles J. Shain,	Isaac S. Williams,	William B. Reaney,
Alfred Young.	Thos. J. Weygandt.	Lawrence Turnbull.

On Meteorology.

Charles M. Cresson,	E. Otis Kendall,
Owen Evans,	Alfred L. Kennedy,
John F. Frazer,	James A. Meigs,
James A. Kirkpatrick,	Fairman Rogers,
Samuel S. Garrigues,	Ayres Stockly.

J. D. Rice brought, for the inspection of the members, a new design for Lightning Conductors. The conductor is formed of fluted tubes of copper, joined by screw sockets, the ends of the tubes abutting, so that the communication is complete. The top is terminated, as in the most approved plans, with a single upright platina point, surrounded by radiating pointed copper wires, set at an angle with a vertical line. The object of the corrugations is, to present a greater surface in a less diameter, and to stiffen the material; they also give the conductor an ornamental appearance, which the generality of them do not possess.

C. P. Weaver explained to the members his design for a sash fastener, consisting of a small shaft, or spindle, having a button on one end and a crank on the other; the body of the shaft passes through a cylindrical casing made in two pieces, held together by dovetails, which is intended to be fastened to the window boards in such a way, that the button end of the shaft comes next the window sash, and at right angles to it. About the middle of the shaft projects a pin, which slides in a helical slot of the casing, and which, by turning the crank one way or the other, brings the button in contact with the sash, or releases it, as may be desired.

When sashes are not counterbalanced by weights, this contrivance will serve to keep the sash at any required height; and, should they be worn, or loosely fitted, any draft may be excluded, or rattling prevented, by forcing the sash against the rebate, by the action of screw movement. All the parts are so cast as to go together, without any fitting, thus making the cost inconsiderable.

BIBLIOGRAPHICAL NOTICE.

Report of the Railroad Commissioners of the State of New York, 1856.

We have been favored by these Commissioners with a copy of their valuable Report, elucidating the working of the railroads of New York, during the year 1855.

This Report is the most able, thorough, and elaborate, document of the kind, which has yet emanated from any department of government in this country, whether state or national.

The means of producing such a work, are only to be obtained in a State, where a separate bureau is charged with procuring, filing, and analyzing, the reports of railroad companies; and such bureau must also be backed by a stringent law, (as in New York,) *compelling* the companies to answer promptly and in proper form.

Even in New York, notwithstanding this law, it appears that some of these powerful corporations, at first were contumacious, and refused to answer. But the Railroad Commissioners with a degree of promptitude

and firmness which does them credit, at once referred the matter under the law, to the Attorney General, who speedily brought these recusants to answer.

Such laws ought to prevail in all our States; for this railroad interest now forms by far the most powerful body of associated capital in this country, and should be kept in strict subjection to the people, by the legislatures of the several States.

Recurring now to the Report in question, the Railroad Commissioners give us first an excellent map of the State of New York, with all the railroads marked thereon, in different colors, whether in operation, under construction, or projected.

Then they give us a copious index, and an excellent essay on railroads in general, comprising 69 octavo pages.

Then follows a series of tables spread over 183 pages, and comprising the Reports of the various railroad companies upon their financial position and operation in 1855, there being in all 55 railroads, including five city passenger railways.

These tabulated Reports in extraordinary detail, give us for each railroad, the characteristics, cost of construction, amount of stock and debts, cost of equipment, cost of working, the earnings of the year, &c. &c.; forming a vast body of valuable items of railroad statistics, which we have not room even to name.

Then follows 112 pages of tabular deductions, giving the most minute details of the expenses and receipts of railroads.

Then we have the Reports of an Engineer (James Laurie, Esq., C. E.) specially charged to examine some suspicious bridges upon various of the railroads. These cover 25 pages, and are very lucid and satisfactory.

Then follows a synopsis of the Reports of the New York Railroad companies, from 1833 to 1855, covering 20 pages; and then comes an analysis of all the accidents resulting in the wounds or death of people.

The letter press terminates with an Appendix, containing a valuable codification of running rules, special inquiries into certain accidents, &c., and the Report is fitly concluded by engravings of full sized cross sections of 74 different patterns of iron rails, used upon the various railways, and these are followed by 17 plates, showing minutely the grade profiles of the leading railroads, and also a small map of the cities of New York and Brooklyn, exhibiting the routes of the city passenger railways.

This brief notice will indicate the elaborate and valuable character of the Report in question, which forms in all an octavo volume of nearly a thousand pages, and, in our opinion, does the highest credit to John T. Clark, William J. McAlpine, and James B. Swain, Esqrs., the Railroad Commissioners of New York, while it cannot fail to be of great service, not only to the people of that state but to our country generally.

Though our space will not at present admit of very copious extracts from this important Report, we cannot refrain from making a few.

It appears that the railroads of New York, are 2616 miles in length, and cost $132,753,104, or rather over an average of $50,000 per mile, which includes equipment.

Of the *narrow* gauge, $4\frac{7}{10}$ths feet, are 1635 miles, and of the *broad* gauge, 6 feet, are 981 miles.

A traveler journeying over all the railroads of New York, would therefore travel 2616 miles, ascend 14,707 feet, descend 17,588 feet, and pass around curves exceeding 140 full circles, or turn round and round that many times in traversing the 50,000 degrees of curvature reported. He would cross 1320 bridges of wood and iron, in all 178,423 feet long, pass over 4361 culverts, and by 8731 road crossings, of which 7649 are level with grade. He would cross 2282 switches, 837 of which have no permanent tenders. He would, or might, see 735 locomotives, and 11,063 cars of various kinds. He would find that in 1855, these railroads moved 471,644,264 passengers *one mile*, and in doing so moved with them 535,244,073 tons of *non-paying* weight one mile, or $1\frac{17}{100}$th tons of dead weight for every passenger carried! Also, that in the same year, 346,217,614 tons of freight were moved *one mile;* and that to effect this, 822,829,025 tons of *non-paying* load was drawn *one mile*, so that for every ton of paying freight, they hauled $2\frac{3}{4}$ tons of dead weight!

In 1855, the earnings of the 55 railroads were	=	$19,597,009
" the expenses "	(58 per cent.) =	11,284,565
Net earnings, . .		$8,312,444

Per Mile Run by Trains, the Expenses were in cents.

	Passenger Transportation.	Freight Transportation.	Both.
For maintenance of road,	= 22	24	23
" machinery,	= 17	20	18
" operating expenses,	= 48	69	58
Totals,	= 87	113	99

It is remarkable that the average cost of running *a train one mile*, on these roads in 1855, making no distinction between passengers and freight, was 99 cents per mile run. Now, many years ago, in the infancy of our system, when the Chevalier De Gerstner investigated the Railways of the United States, he found upon a similar general average, the expense of running a train one mile, *was one dollar;* so that notwithstanding constant improvements in machinery and more extensive experience, we do not seem to have reduced the cost per mile of running trains. But the trains of the present day have doubtless a larger business capacity, and therefore, in effect, a greater economy.

The average cost of maintenance of way, including repairs of iron, averaged $1005 per mile of railroad.

The average number of passengers per train was 72, and per car 16 passengers, while the average distance traveled by each, was 45 miles only.

The average number of tons of freight per train was 71, and per car 4 tons, while the average distance carried, was 102 miles.

The per centage of the number of all passengers, shows the singular result on these railroads, of only 18 per cent. *through*, and 82 per cent. *way!*

This shows the superior importance to railroads of the *local* business, about which little is said, over the through business, which forms the chief burden of railway notices and advertisments.